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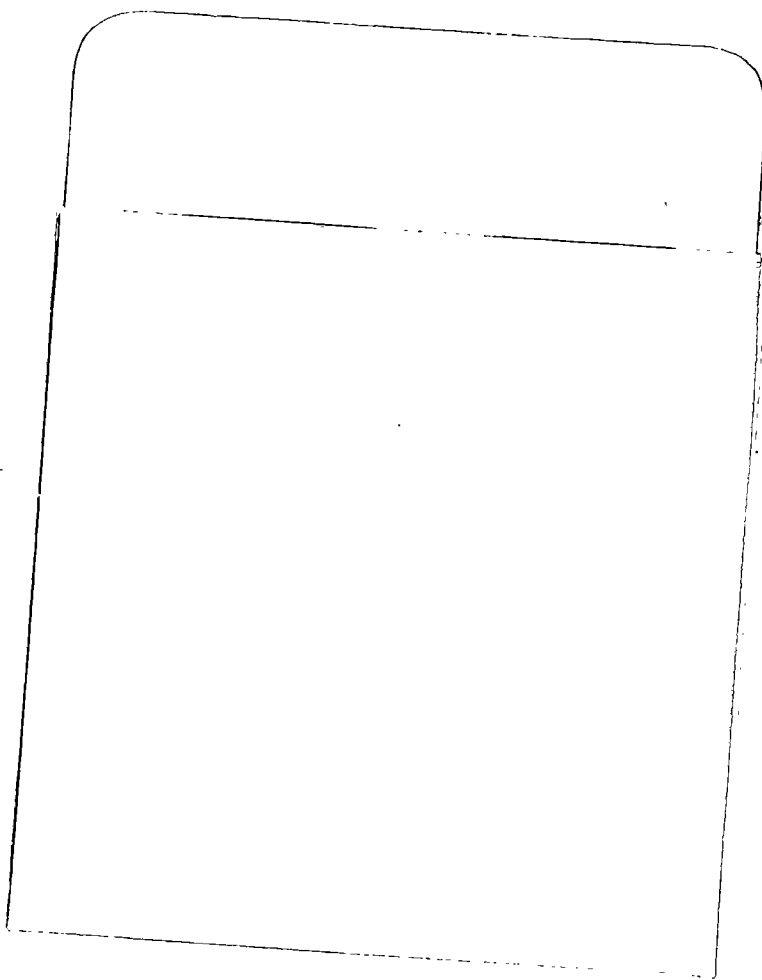
FM 710-27

FIELD MANUAL

**LOGISTICS
INVENTORY
MANAGEMENT**

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HEADQUARTERS, DEPARTMENT OF THE ARMY



FIELD MANUAL

No. 710-27

HEADQUARTERS
DEPARTMENT OF THE ARMY
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PART ONE

INTRODUCTION

CHAPTER 1

GENERAL

1-1. Purpose

a. This manual presents Department of the Army doctrine pertaining to inventory management by prescribing the principles, policies, organizations, and techniques necessary to attain an efficient inventory management system as a part of total logistics management. It furnishes guidance to commanders, staff officers, and logistics personnel who are concerned directly or indirectly with the various functions of inventory management. It also provides material for use in appropriate courses of instruction in the Army school system.

b. Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons will be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to the Commandant, United States Army Logistics Management Center, ATTN: DRXMC-MR-I, Fort Lee, VA 23801 (see AR 310-3 for format on corrections and changes).

c. The word "he," when used in this publication, represents both the masculine and feminine genders unless otherwise specifically stated.

1-2. Scope

a. Basic management task of the Army logistics system requires that the interlocking activities of that system provide a flexible yet adequate control of the total inventory. Requirements planning is the fundamental function of inventory management that

results in the formulation of management decisions concerning the entry, retention, consumption, or disposal of materiel in the system. Corollary functions that stem from requirements planning are: programming, budgeting, cataloging, acquisition, distribution, maintenance, and materiel utilization and disposal.

b. This manual is primarily concerned with the comprehensive coverage of the six functions of inventory management performed at the national inventory control points in the Continental United States, namely cataloging, requirements determination, acquisition direction, distribution direction, maintenance direction, and materiel utilization and disposal.

c. The subject is developed in two parts:

(1) *Part One: General*—Outlines the purpose and scope of the manual. Provides a general background discussion of the functions of inventory management performed at the national inventory control points.

(2) *Part Two: Function of Inventory Control*—Provides a comprehensive description and analysis of the concepts, programs, and techniques employed in the performance of each of the basic functions of inventory control. A separate chapter is devoted to each of these areas:

- (*a*) Cataloging.
- (*b*) Major Item Management.
- (*c*) Secondary Item Management.
- (*d*) Acquisition Direction.
- (*e*) Distribution Management.
- (*f*) Depot Maintenance Direction.
- (*g*) Stock Control Management.
- (*h*) Materiel Utilization and Disposal Management.



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CHAPTER 2

THE ROLE OF INVENTORY CONTROL

Section 1. GENERAL

2-1. Introduction to Inventory Control

The subject of inventory control is prevalent throughout all aspects of the military logistics system. Attaining the most effective and efficient inventory control is a primary objective in the materiel support mission of the Army. To fully understand the inventory control relationship to the overall logistics mission, a review of the total logistics management responsibilities is necessary. Army logistics (AR 310-25) is the science of planning and carrying out the movement and maintenance of forces. In its most comprehensive sense, these aspects of military operations deal with:

- a. Design and development, acquisition, storage, movement, distribution, maintenance, evaluation, and disposition of materiel.
- b. Acquisition or furnishing of services.

2-2. The Objective of Inventory Control

The objective of inventory control is effective, efficient, and economical supply to the military forces in their assigned missions. With the many compromises and trade-offs that are necessary in the operation of Army logistics, this ultimate objective can become obscure, for at all levels of the supply system there are limitations or restrictions in availability of moneys, transportation, facilities and labor, as well as materiel. Logisticians specify standards for materiel support that will insure an acceptable level of service to supported units, and inventory managers continually examine every function in the system in an attempt to balance available resources to reach or surpass the defined standards of performance. However, even with the best possible management practices, emergency supply actions are necessary to meet unpredictable contingencies. The standards set for any function serve as guidelines for operating personnel and control indicators for management. The ultimate criteria for evaluating the inventory management system is success in supporting the soldier in the field with what is needed, when, where, and in the condition and quantity required at minimum expenditure of resources.

2-3. Inventory Control and the Life Cycle of Materiel

In addition to determining the relationship of inventory control to overall Army logistics, it is also necessary to understand the position of inventory control in the life cycle of materiel. The life cycle of a system or an item of materiel begins with its conception, progressing through research and development, continuing through its production, deployment, and use, and ending with reutilization or disposal when the item becomes excess, uneconomically repairable, or obsolete. The major functions of inventory control that occur during the different phases of the life cycle are:

- a. *Exploration of Alternative Systems Concepts Phase.*
 - (1) Development/acquisition strategy.
 - (2) Distribution/deployment variables.
 - (3) Qualitative requirements planning.
- b. *Demonstration and Validation Phase.*
 - (1) Cataloging.
 - (2) Quantitative requirements planning.
 - (3) Acquisition direction/planning.
 - (4) Distribution planning.
 - (5) Basis of issue determination.
 - (6) Maintenance planning.
 - (7) Facility requirement planning.
- c. *Full-Scale Engineering Development Phase.*
 - (1) Quantitative requirement planning.
 - (2) Acquisition direction.
 - (3) Distribution planning.
 - (4) Maintenance package requirement.
 - (5) Cataloging finalized.
 - (6) Provisioning plan.
 - (7) BOIP revised/finalized.
 - (8) Facility requirement update/deployed.
 - (9) Provisioning plan implemented.
- d. *Production and Deployment Phase.*
 - (1) Quantitative requirement computation.
 - (2) Acquisition direction.
 - (3) Distribution management.
 - (4) Maintenance management.

(5) Stock control.

(6) Reutilization and disposal.

(Although an inventory manager may become involved in any of the foregoing functions, his management effort is mainly expended in the Production and Deployment Phase of the life cycle of materiel.)

2-4. Inventory Control and the Materiel Pipeline

a. To perform with maximum effectiveness, the inventory manager must understand the scope and complexity of the total materiel pipeline. This materiel pipeline exists for one purpose—the effective movement of supplies from the producer to the user in an economical manner, in as nearly a straight line as possible, with a minimum number of intermediate stops. Two major responsibilities to be considered in pipeline management are: (1) the determination of when and what quantities of items are to be placed into the system; and (2) control of these items while in the system. It should be recognized, however, that separate methods operate simultaneously (e.g., general supplies, ammunition, medical supplies), and that echelons of stockage may be increased or decreased to conform with needs of the commands, proximity of user to support complexes, and other operational factors.

b. Because of the extended length of the total pipeline and the different echelons involved in its operation, control of the flow of materiel is regulated by a number of different units or activities. Each of these activities is, therefore, “in charge” of a particular segment of the pipeline and must fulfill the following basic requirements:

(1) To keep his assigned segment of the pipeline “full.” That is, to insure that there are sufficient assets in movement or in storage at all times so that supply will not be interrupted; and

(2) To order sufficient supplies at the proper intervals to meet anticipated future demands upon his echelon of supply.

2-5. Approaches to Analyzing Inventory Control

a. To understand Army inventory control, it is helpful to analyze the factors that produce management distinctions in the supply system. These distinctions sometimes resemble separate systems and can cause confusion unless the controlling factors are thoroughly understood. Four approaches to viewing the supply system are discussed by:

(1) Criticality of materiel.

(2) The environment in which supplies are to be used (including the distance from the supply source).

(3) The capability of the system to generate demand data (e.g., the ability of the user to prepare formal requisitions).

(4) Classes of supply.

b. The first approach to viewing the supply system is by degree of criticality of the materiel being managed. Ammunition, for example, is managed intensively at all levels because of its essentiality. Bulk petroleum is another combat-essential item, and, because of its unique movement and storage characteristics, it requires special management techniques to insure adequacy of supply. In addition to such critical materiel, specific combat situations or environments may dictate the need for intensive management or special control for specified categories of materiel. For example, where air mobility of personnel and equipment is essential to mission accomplishment, it is of critical importance that aircraft be kept in a flying status. In these instances, a decision may be made to establish special control measures for support of critical equipment.

c. The second approach to analyzing the supply system is by location and activity of the user. To illustrate, compare the supply of installations in the United States with those of Asia. The interval between placing an order and receiving supplies (order and shipping time) for example, may be 30 days in the United States and 82 days in Asia. Consequently, unpredicted increases in materiel consumption may have little impact in the United States whereas in Asia they can cause serious emergencies. All the problems of operating on foreign soil, in underdeveloped regions, and in combat of varying intensity, combine to necessitate the tailoring of the standard supply system and the addition of special management features not needed in the United States. Plans for training and combat must be anticipated in planning oversea stock levels. Air shipment, over-the-shore unloading of ships, and contractual maintenance are examples of techniques which may require emphasis. For the supply system to meet this target, command emphasis must be brought to bear on all aspects of the order/ship time cycle.

d. The third approach to viewing the supply system is by its capability to generate demand data. In stable operations, the demand for supplies can be predicted by projecting past demand rates. It is the Army policy that “push shipments” will not be authorized. However, when experience in a particular environment is limited, shipments for initial support of forces and equipment, through the demand based development period, may be preplanned, but will be made only when the recipient has participated in the item selection, has full knowledge of the shipment content, and has called it forward. This approach must be carefully controlled to insure that units receive what they require and that excesses are not generated because of oversupply.

e. The fourth approach to viewing the supply system is by class of supply. There are 10 classes of

supply that group all items by major commodity characteristics. These are—

(1) *Class I.* Subsistence, including gratuitous health and welfare items.

(2) *Class II.* Clothing, individual equipment, tentage, tool sets and tool kits, handtools, administrative, and housekeeping supplies and equipment. Includes items of equipment other than principal items prescribed in authorization/allowance tables, and items of supply (not including repair parts).

(3) *Class III.* POL: Petroleum fuels, lubricants, hydraulic and insulating oils, preservatives, liquid and compressed gases, chemical products, coolants, deicing and antifreeze compounds, together with components and additives of such products, and coal.

(4) *Class IV.* Construction: Construction materials to include installed equipment, and all fortification/barrier materials.

(5) *Class V.* Ammunition: Ammunition of all types (including chemical, radiological, and special weapons), bombs, explosives, mines, fuzes, detonators, pyrotechnics, missile, rockets, propellants, and other associated items.

(6) *Class VI.* Personal Demand Items (Nonmilitary Sales Items).

(7) *Class VII.* Major End Items: A final combination of end products which is ready for its intended use (principal items); e.g., launchers, tanks, mobile machine shops, and vehicles.

(8) *Class VIII.* Medical Materiel including Medical Peculiar Repair Parts.

(9) *Class IX.* Repair Parts (Less Medical Peculiar Repair): All repair parts and components to include kits, assemblies, and subassemblies, repairable and nonrepairable, required for maintenance support of all equipment.

(10) *Class X.* Materiel to Support Nonmilitary Programs; e.g., Agricultural and Economic Development, not included in Classes I through IX. Each of these classes of supply presents certain distinctive patterns for inventory and distribution management. To an extent, viewing supply in terms of classes of supply overlaps some of the other approaches (e.g., bulk petroleum and ammunition are examples used also in the first and second approaches). Nevertheless, the classes of supply were designed to group items of supply which have similar management characteristics. Therefore, the classes of supply provide an especially useful vehicle for analyzing major supply system deviations.

f. One or more of the above approaches to viewing the supply system may be useful in the analysis and solution of supply problems. For whom or what is the materiel managed? Considerations involved in calculating requirements for supporting personnel differ from those for supporting equipment. What is the capability of the system (or segment of the system) to generate useful demand data? A mathematical technique that is highly effective for stable demand in peacetime may be worthless during the first month after an invasion. What is the class of supply? The division of materiel into classes of supply helps in identification of unique materiel characteristics to be considered. Logistics managers must continuously evaluate the effectiveness of the supply system. In searching for means to improve the system, stockage points may be consolidated or eliminated, central data banks established, or new management controls imposed: but all changes must be considered in the light of every related aspect of the system. Viewing each problem or proposed system improvement from several points of view will help insure a coordinated solution.

Section II. COMPLEXITY OF INVENTORY CONTROL

2-6. The Challenge

a. The primary purpose of inventory control, as a part of total logistics, is the provision of needed supplies to support troop operations. As the nature of warfare changes, logistics—if it is to be successful—must adapt itself to these changes. During periods when means and methods of combat are relatively stable, moderate adjustments in logistics concepts may suffice. When revolutionary changes are occurring in combat capabilities and techniques, it behooves the logisticians to intensify their analysis of logistics methodology to insure that logistics management is keeping pace. Inventory managers, at all levels, must be alert to any new product, concept, or technique developed by industry or the Government itself which can be used to improve the effectiveness or economy of Army inventories.

b. The Army's inventory system must be continually modernized and ever-increasing emphasis must be placed on the speed and efficiency of supply operations, particularly in the area of accurate and timely requirements computations. Increasing automation permits faster and more sophisticated manipulation and analysis of huge masses of data. Decisionmaking is becoming even more demanding and a premium is placed upon trained inventory managers who can quickly separate vital facts from trivial details and make accurate decisions on a basis of logical deduction.

c. Predictions within the Army are influenced by such intangibles as the ever-changing national policies relating to international politics, national budgetary limitations or restrictions, steady advancement of military technology, and current research and

development of new combat concepts that require changes in force structure which dictates the logistics concepts and equipment allowance necessary. Also, because of the remoteness of prospective combat areas, the U.S. Army must plan for longer, more vulnerable materiel pipelines. What is actually needed is an optimum wartime supply system in being at all times. However, pressures for economy prevail in peacetime and, as a result, the Army must accept a supply system which represents a compromise between what it needs and what it can afford. These overriding considerations place emphasis on both effectiveness and cost of supply. It is the task of inventory managers to appraise and control the cost of supplying needed materiel on time and in required quantities without impairing the ability to supply. This is indeed a difficult task necessitating the highest degree of management competence.

2-7. The Response

a. The Army constantly strives to increase and improve its combat capability to meet the ever-changing challenge of potential adversaries. In this endeavor it strives for qualitative superiority in communications, firepower, mobility, and materiel support in depth rather than attempting to match potential enemy forces man for man. Fast, efficient means of communications are being developed to provide information on a timely basis. Emphasis is being placed on air transportability of weapons, equipment, and backup support to bolster combat effectiveness. Through the use of measured modernization, it is promoting a more orderly flow of new items into the inventory. It is using its assets fully by aiming at a goal of peak efficiency at the lowest possible cost.

b. To speed the decisionmaking process on higher levels and to reinforce control of funds and programs, improved and selective management techniques have been adopted. Automatic data processing programs are being used to bring under control the mass of management data the Army collects on its varied and far-flung activities. Use of mathematical models has been increased to provide optimum and timely solutions to inventory problems.

2-8. Management Concepts

a. In view of the size, variety, and changing characteristics of the Army inventory, it is apparent that it can be managed effectively only if the task is broken down into manageable segments. The basic philosophy in approaching this task is generally one of management by exception, and selectivity of management time and effort based upon the importance and dollar value of items. The inventory is broken out into segments:

(1) *By materiel readiness organization.* The operating commands of the US Army Materiel Development and Readiness Command (DARCOM) are essentially commodity organizations charged with the management of items peculiar to their respective missions.

(2) *By materiel readiness.* Within DARCOM there are commodity management centers—national inventory control points—at which the national level management of inventories of assigned commodities is carried out. The inventory manager at a national inventory control point is responsible for the management of specific items within the commodities assigned to him. This responsibility includes cataloging, requirements computation, acquisition, distribution, overhaul and rebuild, materiel reutilization, and disposal. As a result, all the wholesale functions of inventory management for any given group of items are centralized in one individual at one place.

(3) *By funding categories.* The inventory is divided into categories which are distinguished by the type of procurement appropriations used to obtain items. These categories are—

(a) *Major items.* Procurement Appropriation (PA); five separate Army appropriations for aircraft, missiles, weapons and tracked vehicles, ammunition, and other procurement.

(b) *Secondary items.*

1 Procurement appropriation.

2 Stock fund.

(c) *Medical secondary items and repair parts, stock fund.*

(4) *Project management.* While not a specific segmentation process by itself, project management is a specialized method of handling a particular weapon or equipment system by a single individual assigned as the project manager. This method provides for various techniques of planning, controlling, progress reporting, and decisionmaking. It establishes a basis which allows for a single authority to plan, direct, and control a weapon or equipment system. It includes all phases of research and development, acquisition, production, distribution, and logistics support to maintain a balanced program for the acquisition of operational systems and equipment from its inception to its disposal. Project management of selected critical or complex items involves interrelationship with a number of major and secondary item managers. The designated project manager for a given item is responsible for coordinating the management of the item among and between the materiel readiness commands. In a sense, the project manager “cuts across” organizational lines to expedite the development, acquisition, and control of the item.

b. Because of strategic, economic, and inventory control necessity and similarity of characteristics, the categories mentioned above are further grouped into two broad areas; major items and secondary items (including repair parts). This segregation is a valid and desirable management technique to differentiate between the methodologies applicable to the acquisition requirements planning, and distribution policies established for these items. These categorizations represent two entirely divergent management systems.

(1) The first grouping is major items. These items are included in requirements and authorization documents (Tables of Organization and Equipment (TOE), Modified Tables of Organization and Equipment (MTOE), Tables of Distribution and Allowances (TDA), Common Tables of Allowances, and Joint Tables of Allowances) which serve as the basis for requirements and distribution planning. For an item to be managed as a major item it must meet all of these three criteria:

(a) *Criteria A.* To insure the operational readiness of the Army, this item requires centralized management and control of requirements determination, acquisition, maintenance, disposal, and worldwide assets and distribution at all support levels down to and including direct support unit levels.

(b) *Criteria B.* The unit value is \$1,000 or more, and/or the total inventory and/or programed acquisition is greater than \$500,000 and/or a budget line is required for this item. Each unit of this item is individually justified, authorized, and budgeted at DA level.

(c) *Criteria C.* The worldwide requirements for this item are individually specified, computed, and programed in accordance with The Army Authorization Documents Systems (TAADS) and/or TOE's.

(2) The second grouping, secondary items, can be identified as being repair parts, major components, and minor type complete end items both consumable and repairable. Future requirements for these items are computed on the basis of past demands adjusted by plans and programs for the future. Some are exceedingly high-cost, critical items requiring comprehensive management attention while others are low cost, have a short leadtime, are easier to procure, and need less management emphasis. Some secondary items (PA) are included in authorization documents, and are also essential to combat. It is in this grouping that the application of selective management is most profitable.

Section III. PROBLEMS

2-9. General

Although the Army had developed logical and workable solutions to the intricacies of inventory control, there are still a number of problem areas which make it difficult to accomplish the task with optimum efficiency and accuracy. For example—

a. Modernization is one of the most perplexing problems facing the Army today. To maintain an acceptable combat readiness posture in relation to rapid technological change with its attendant high rate of obsolescence, and to do it with limited funds, poses the questions as to what to buy, when to buy, and how much to buy. In addition to being faced with the problems generated by introducing a new item into the inventory, the manager is also faced with the problem of what to do with the item that is being replaced and to be phased-out of the system.

b. Reduction of items in the inventory commensurate with adequate support to troops is essential. Through Department of Defense standardization and utilization programs, the Army must maintain constant vigilance to insure that—

(1) All items of supply are items for which a real need exists, eliminating those which fall into the nice-to-have category.

(2) Maximum use of interchangeability to provide optimum utilization of assets and reduce expenditures for new acquisition.

c. Reduction of repair parts is a function of maintenance policy and practice. The greater extent of repairs permitted at forward echelon results in a higher requirement for a broader range of repair parts and larger inventories.

d. Accumulation of asset data to be used in computing net requirements poses a continuing problem for the inventory manager. It is essential that the required asset reporting be accomplished accurately and timely. The number of makes and models, together with their worldwide distribution, further aggravates the problem. Experience in the past has indicated that accurate data are difficult to obtain.

e. Demand analysis is, as it implies, an analysis of demands placed on the inventory manager at the national inventory control point. This analysis is necessary to determine the relationship between recurring demands and nonrecurring demands as identified by the requisitioner. Demands must be screened to identify the one-time initial issue, program or project demand, and the abnormal requisition. These must be analyzed as to whether they represent unusual demands caused by a particular event or circumstance that should not occur again or are a true normal demand which can be used in projecting future demands.

f. Many of the inventory manager's problems actually stem from limitations in funds and resources. It

is recognized that unlimited funding and resources are not practical possibilities. This problem must be faced since it causes the inventory manager to provide the most accurate and efficient management to support the total Army materiel requirement at minimum cost. When funds are limited, managers may have to delay procurement or overhaul on some items in order to use available funds to purchase or maintain items which are more urgently needed.

2-10. Magnitude of the Inventory

a. There are few management responsibilities in the world today which parallel, in scope and complexity, that of managing the Army's inventory. Some of these problems arise from its size and diversity; others are due solely to the many echelons through which an extended materiel pipeline must reach out to support combat forces located throughout the world.

b. Of foremost concern is the size and value of the inventory itself; if it is larger than necessary to meet current and anticipated needs, the cost of maintaining the system is substantially increased. Excessive inventories also raise costs associated with obsolescence and eventual disposal. As the cost of managing the Army supply system varies with the size of the inventory, continued emphasis is placed on the assessment of supply performance in terms of—

- (1) What is being done.
- (2) How efficiently is it being done.

2-11. Diversity of Items

a. The management of a multibillion dollar inventory is a monumental undertaking. The task becomes even more complex when items within the inventory range from those—

(1) Which are low cost and easily obtainable, to those that are high cost, difficult to procure items with exceptionally long production leadtime.

(2) With readily identifiable demand and distribution patterns to those which are difficult to forecast because of erratic demand and eccentric distribution.

(3) Specialized items of equipment which are distributed on a geographical basis due to a multiplicity of makes and models, to items distributed on a special basis to selected units and organizations.

b. Further, support of these end items with components, assemblies, subassemblies, and repair parts presents an even more complex problem to the inventory manager.

2-12. Modernization

Technological change is a constant and desirable factor but poses the problems of what items to procure, how many, and how long they should be retained in the inventory. Improvements in weapons and their employment have always been a necessary adjunct to military responsibility; however, the introduction of new weapons and equipment poses complex problems for inventory managers. Planning and procuring for war reserve requirements are difficult when modernization is necessary. Army policies on the introduction of new equipment as well as product improvement through the introduction of new models is contained in AR 11-8.

2-13. Absence of Profit Motive and Competition

a. Competition is closely related to the profit and loss basis on which commercial industry conducts its operations. The pressure of competition acts as an incentive to better performance, resulting in higher profit-taking versus lower inventory investment. A commercial firm that permits poor management to lead to stagnant inventories will soon be bankrupt. The continuing pressure of competition on businessmen probably accounts for much of the progress and increasing efficiency which characterizes the American economy.

b. The Army inventory control system, on the other hand, has competition or profitmaking desires when supplying customer demands. If supplies are not available, the customer must usually wait or do without. When foreign customers are involved, US Government and US Army prestige may be adversely affected. In addition, third-country purchases of major end items may result to the detriment of US standardization objectives. The US Army customer cannot take his business elsewhere as his civilian counterpart might do. He has no alternate source of supply. Consequently, the Army has a far greater responsibility to its customers and must be prepared to meet legitimate demands.

c. The Army inventory control system exists to serve a military need, not an economic end. Certain supplies cannot be supplied economically; however, this does not relieve the Army of the responsibility of furnishing them. From the viewpoint of the inventory manager, the competition for limited resources requires efficient planning, programing, and management by professional logisticians to provide logistics support that is consistent with tactical requirements and within national economic constraints.

Section IV. DESCRIPTION OF INVENTORY CONTROL FUNCTIONS

2-14. Integrated Functions

a. Within a national inventory control point, individual inventory managers are assigned a given number of items for support of specified end items, or Federal supply classification groups or classes within a category for integrated inventory management. Each of the functions of integrated inventory control will be discussed in detail in subsequent chapters and can generally be described as follows:

(1) *Cataloging.* The inventory manager must insure that the items are properly cataloged and recorded in appropriate working file sections of the Army Master Data File (AMDF) so that the worldwide customers will know what the item is, what the item does, what stock number to use, what the unit cost is, and where to submit his request for the item. Although the Defense Logistics Agency has responsibility for maintaining the Federal Catalog System files at the Defense Logistics Services Center, the individual inventory managers have responsibility for initiation of cataloging actions into the catalog system for items they manage and for changes thereto.

(2) *Requirements determination.* The inventory manager is responsible for the planning and computing of peacetime and mobilization requirements for assigned items. He is also responsible for computing Military Assistance Grant Aid requirements based upon demand history and maintaining stockage levels in support of Cooperative Logistics Supply Support Arrangements. The degree of authority invested in the manager and the amount of review for approval by higher authority are related closely to the type of item involved, category of funds to be expended, and dollar value of projected inventories.

(3) *Acquisition direction.* The inventory manager has the authority to direct acquisition to be accomplished, subject to limitations of approved programs and direction from higher authority. Close coordination between the inventory manager and procurement personnel is essential.

(4) *Distribution direction.* The inventory manager controls stocks which are in storage, due in, or due out for the entire CONUS depot distribution

system on both a quantitative and monetary basis with the exception of Selected Item Management System-Expand (SIMS-X) items. For SIMS-X items this control extends to CONUS installation and oversea theater depots and/or direct support units. This distribution management function involves the control of inventories to insure that they are adequate, but not excessive, and that they are strategically located so as to be most responsive to customer demands. It also insures that redistribution actions are taken in lieu of acquisition action particularly for SIMS-X items.

(5) *Maintenance direction.* The inventory manager has the authority to require that items be overhauled. In computing requirements, all assets (serviceable and economically repairable unserviceable) must be considered. Close coordination between the inventory manager, equipment specialists, and maintenance personnel is necessary to consider overhaul/rebuild capacities versus related quantities and time schedules desired by the inventory manager. The users must be brought into the planning process to insure the timely return of unserviceable assets.

(6) *Materiel utilization and disposal.* The inventory manager must insure that excess or obsolete stocks are removed from the system. He is responsible for the declaration of excesses and, when the item has been declared excess to the Federal Government, takes further action to effect disposal. He must conscientiously participate in the DOD materiel utilization program to insure proper utilization of excess stocks prior to disposal.

b. The efficiency of the total logistics system is contingent upon an effective interrelationship among all function divisions of the system. This principle relates to the five major functional divisions of the logistics system (supply, maintenance, transportation, services, and facilities) and their related sub-functions. It emphasizes that effective and efficient logistics operations depend on the degree to which the function within the operating system either can be coordinated (i.e., properly interfaced) or, where feasible, integrated.



PART TWO

FUNCTIONS OF INVENTORY CONTROL

CHAPTER 3

CATALOGING

Section 1. THE SIGNIFICANCE OF CATALOGING

3-1. The Problems of Identification and Classification

a. The identification and classification of things, whether they be insects, plants, or material items of supply, has always been one of the fundamental concerns of scientists and managers. The efficient and effective manager has to know what he is managing; he must catalog, classify, and identify all elements of his operation. Similarly, the classification of items of supply in a useful, orderly, and responsive system is basic to the inventory management effort.

b. The concept of inventory or item management has existed in a military environment since the earliest days of group warfare. Consequently, the problem of inventory control, along with the basic necessity to identify and classify items, has also existed since the beginning of organized military establishments. As will be seen, the earlier efforts at establishing a system for the cataloging of materiel were decentralized and, in many cases, redundant. The logistics function of today, however, requires a unified cataloging operation which is centralized in terms of management control but decentralized in most operations.

c. The inherent complexities of the present logistics system with its worldwide commitments and a materiel budget of 40 to 60 billion dollars a year, along with the rapid infusion of new and improved weapons systems, demand that the system of identification and control of these items be continually monitored and maintained. Within this framework, this portion of the manual will provide a comprehensive coverage of the concept of the cataloging effort, the systems established to insure continuing efficiency, and the operations involved in producing usable data for the inventory manager. In addition, the chapter will cover the problems and operations involved in the introduction of new items into the supply system, the screening and revising processes

which are necessary to maintain reliable data in catalogs, and, finally, the deletion process by which items are taken out of the catalog system.

d. The term "cataloging" as used in this manual has a much broader connotation than is usually attributed to the word. In defining the words "catalog" and "cataloging," these words mean much more than "the naming and numbering" of items. A standard dictionary states that a catalog is "a list of names, titles, or articles arranged methodically, often alphabetically, usually with descriptive details, number and price accompanying each item; a book or pamphlet containing such a list." Collectively, the cataloging function is referred to as the Federal Catalog System. The purpose of this system, which will be discussed throughout this chapter, can be summarized as follows—

The system was established to improve supply operations and to permit greater efficiency in the managerial control of items within and between the supply systems of the Army, Navy, Air Force, Marine Corps, other Federal agencies, NATO, and friendly foreign countries. It is an information-providing service whose mission is to obtain, verify, record, and to provide to management certain item information not otherwise obtainable. The system, in the form of a "catalog":

(1) Establishes a single supply language of item identification.

(2) Provides accurate information as to the identity of an item of supply.

(3) Records the source of supply of items.

(4) Records the governmental activities (including NATO and friendly foreign countries) which manage or have an interest in each item of supply.

(5) Provides such other item management data as the user may require. This listing of what the catalog system provides is helpful in defining the

word cataloging. Within the Army, the term cataloging encompasses both the action taken to make or change an entry in a catalog and the production of a catalog; i.e., the physical compilation of the data to be used either in the form of a "book," magnetic tape, printout, or memory unit in a computer.

3-2. The Federal Catalog System

a. The Federal Catalog System is, first of all, a Federal system—it is Government-wide in its operation; it applies to all stocked items of supply in the Department of Defense (DOD), as well as the civil agencies of the Government, which are repetitively acquired, stocked, controlled, and subject to central inventory management. All cataloging activity in the Government operates within the framework of the Federal Catalog System, which is designed to develop a single uniform method of cataloging and maintain it thereafter for use as an effective tool in all logistics functions. The system also serves as a control or monitoring agency to prevent duplication in procurement and distribution of new support items. Cataloging serves the various supply functions and management concepts, whatever their state of uniformity. The system is flexible and can adapt its cataloging processes to differences in supply systems. It serves as a managerial tool to influence uniformity and to establish standardization programs.

b. The unified system was developed relatively recently; however, it essentially was, and still is, an evolutionary process. During both World Wars I and II, the supply of all the Armed Forces was hampered by the lack of an adequate and unified system of item identification. There were few critical shortages of supplies, but there were hundreds of thousands of incidents where the wrong kinds of supply items were ordered, procured, and distributed.

(1) Essentially, the problem was caused by different stock numbers for items used by the various branches of the Army. Control of military operations became centralized in the Joint Chiefs of Staff during World War II, but supply management was not centralized partly because such a task could not be undertaken in wartime, and partly because of the way in which the Army supply system was organized. Despite the centralization of command, the Army still had technical services which continued to operate separately. Each had different names, numbers, and specifications for exactly the same item, describing it in several ways. Even within a technical service, there were cases where an item was carried under 26 different stock numbers.

(2) As a result of these various supply systems in the Army, a critical shortage of an item at one location might not be a true shortage at all because precisely the same item might be right in the same warehouse, packed and coded under a different num-

ber and description. This was not only costly duplication, but it interfered with strategic supply planning and was an actual danger to the national economy and security. This failure of communication and identification was not confined to the Army supply system; it also included all other services and Federal agencies.

(3) Various study commissions during and after World War II revealed one fundamental need—the establishment and use of a common, understandable system for the effective, efficient, and economical management of the materiel resources of the DOD. Recommendations and corrective actions taken from the later years of World War II through the postwar period gave impetus to the cataloging effort. The National Security Act of 1947, for example, established requirements for single agencies to procure certain commodities for all other services. In 1949, however, a major step was taken to centralize the cataloging functions of the services. Public Law 152 of the 81st Congress, as amended, required the General Services Administration to establish a uniform Federal Supply Catalog System in coordination with the Secretary of Defense. The act further required that each Federal agency utilize the uniform Federal Catalog System. Subsequently, Public Law 436, "The Defense Cataloging and Standardization Act," was passed by the 82d Congress in 1952, and assigned responsibility to the Secretary of Defense to prescribe a single catalog system for the Department of Defense. Today the responsibility for the overall supervision of the Federal Cataloging Program rests with the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics (MRA&L)) who has final approval authority for all of its policies and programs. The programs are coordinated with the Administrator of General Services, who is designated by public law as being responsible for carrying out the program for civil agencies of the Federal Government. The Director of the Defense Logistics Agency (DLA) administers the operation of the Federal Catalog System governed by the policies, plans, programs, and guidance provided by the Assistant Secretary of Defense (MRA&L). The Secretaries of the Army, Navy, and the Air Force are charged with seeing that the provisions of the program are adhered to and carried out by the operating elements of their respective services. These responsibilities have been delegated to the Assistant Secretaries for MRA&L, who, in turn, establish points of liaison, designated as the departmental headquarters catalog office. Responsibility for the central processing of cataloging actions and the maintenance of the central repository and automatic data processing (ADP) files is assigned to the Defense Logistics Services Center (DLSC). Although operations of the catalog system are conducted in the DOD on a

decentralized basis, there is a centralized control of management policies. This is in keeping with the general policy within the DOD of centralized management—decentralized operations.

c. It is essentially the individual supply manager, however, who initiates the item of supply concept for this item of supply. The item identification for this item of supply is prepared by the cataloging subdivision of the cognizant supply center, departmental inventory manager, or by another activity serving as the cataloging agent, and is submitted to DLSC for review, screening, approval, stock numbering, and publication in microfiche or card form. DLSC exercises overall control of the centralized operations of the system by development and publication of the rules, procedures, and tools governing the preparation of catalog data, by the approval or disapproval of data prepared by activities and by field visits to the preparing activities. The central review, approval, and stock numbering of item identifications has been, and is today, an essential element in the establishment and maintenance of a truly uniform catalog system.

3-3. Elements of the System

There are certain basic considerations of the cataloging system. They are item identification, classification, stock numbering, and the publication of data.

a. The first and most important element of any cataloging system is the positive establishment of a unique identification for an item of supply. Under the Federal Catalog System, the concept (the understanding of mental impression) of an item of supply is expressed in, and fixed by an item identification. The item identification consists of the minimum data adequate to establish clearly the essential characteristics of the item, which gives the item its unique character, and make it what it is, and differentiate it from every other item of supply used in the Federal Government. Each item identification is applicable to one and only one item of supply and, conversely, each item of supply has only one item identification. The identification and differentiation of an item of supply rest on the characteristics inherent in the concept of the item. The characteristics of an item of supply are basically of two kinds: physical characteristics and performance characteristics. Generally, the characteristics of an item can only be disclosed by technical research which is the foundation for the process of item identification. The first element in establishing the characteristics of an item of supply is the name, which answers the question, "What is it?" Under the Federal Catalog System, a single name is established for each item of supply and regardless of how many different activities use the item, they will call the same item of supply by the same name. This means that, under the Federal Catalog System,

it is necessary to research and agree on the selected names and definitions, when required, so that all activities in DOD can speak the same language. Industrial and commercial names are used where uniform names exist in industry or where industry has agreed to uniformity. These are called Approved Item Names and are published, together with their necessary definitions, in the Federal Item Name Directory for Supply Cataloging, Cataloging Handbook H-6 (SB 708-6). This handbook also incorporates other names, including the names applied to the items by industry, which are referenced to the Approved Item Names. This handbook is the most comprehensive dictionary of supply item names in the military supply system; it bridges a gap in item name language between Government and industry and provides the basis for greater uniformity of understanding in contractual relationships. For those specialized or proprietary items, where the name is governed by the design or function of the part, the name established by the manufacturer or designer is normally used. In those cases, however, where more than one name exists for the same item, a single name is selected for use in the Federal Catalog System.

b. The second element in establishing the characteristics of an item of supply is the identification data which, when the item can be described, is stated directly by using words to describe the essential characteristics, including physical, mechanical, electrical, chemical, material, dimensional, and performance data (descriptive method); or which, when the item cannot be described, is stated indirectly by citation of reference(s) to the item identifying number(s) and the supporting technical data, such as blueprints, specification, of one or more manufacturer's (reference method) number. The descriptive method of item identification requires the use of Approved Item Names and Federal Item Identification Guides (FIIG's). Each item name approved for use in the descriptive method is referenced to a specific FIIG which contains a series of requirements (questions) regarding the technical characteristics of the item of supply covered by the item name. Replies to these requirements result in a statement in a prescribed sequence of the characteristics of the item of supply. This is the item identification. As an additional tool for the descriptive method of item identification, the Federal Catalog System utilizes illustrations and drawings to represent pictorially those characteristics of items of supply that cannot be presented directly in words such as specific shape, angle, size, type and method of measurement. These are called reference drawings. The descriptive method is supported by the manufacture's data (name, address, and manufacturer's number(s)) for item being identified. The reference method of item identification is an indirect process of identifying items of sup-

ply, not through words, but by reference to the item-identifying number(s) and the supporting technical data of one or more manufacturers. The reference method is used to identify items when the descriptive method is not practical. Airframe structural parts, engine parts, and technical repair parts are examples. Many of these items are designed for a single application and often are proprietary to a single manufacturer. The reference method of item identification is based upon reference to, and is supported by, the manufacturer's data which includes the name of the manufacturer, his address, and his identifying number or numbers for the item being identified. The manufacturer's number for the item is supported by his blueprints, specifications, and methods of manufacture and is considered to be the most authoritative identification available.

c. The Federal Supply Classification is the basic classification system used by the DOD and the Federal Government. It was developed by joint representation from OSD and the Departments of the Army, Navy, and Air Force, with the General Services Administration. The Federal Supply Classification (FSC) allows 99 major segments called FSC groups. Each of these groups is assigned a two-digit code. While the two-digit structure permits 99 groups, spaces have been left so that anticipated expansion would not disturb groups already established. As a further subdivision for management purposes, each two-digit FSC group is divided into classes. Each class is designated by an additional two digits, thus making a four-digit code classification. For example, FSC Group 31, Bearings, is divided into the following three classes:

3110—Bearings, Antifriction, Unmounted

3120—Bearings, Plain, Unmounted

3130—Bearings, Mounted

Each item in a supply system which is identified under the Federal Catalog System will have assigned to it one four-digit class code. An item is classified either by "what it is" (bolts in the bolt class, electron tubes in the electron tube class) or "where it fits" (the pedestal in the same class as the ventilating fan, the platen in the same class as the typewriter). The term "application coding" refers to the classifying of an item according to "where it fits." This takes place primarily in the machinery and equipment areas. As a rule, an application-coded item must be designed especially for the object with which it is used. A bearing or a gear is application-coded when it is especially designed for one application, but when it has applications on two or more kinds of equipment, it is classified in the bearing class or gear class. Other kinds of items, treated in the same way as bearings and gears, are gaskets, various power transmission components, pumps, and valves. The Federal Supply

Classification, with its present structure of groups and classes, represents those groupings and relationships which are dictated by current management needs as well as those of the possible future. As the needs of management change, additional groups and classes will be developed, the definition of others will change, and the techniques of classification will also follow the needs of management. The classification system is an internal management tool used by DOD, GSA, and civil agencies and is governed by daily management requirements. The uniform Federal Supply Classification provides uniform management categories throughout military organizations, functions, operations, and supply pipelines. It permits greater uniformity within and between the functions, operations, and supply pipelines. It permits greater uniformity within and between the military services in the operations of reporting, accounting, financial management, inventory control, and budgeting. The next basic element is on the National Stock Number (NSN). Having established the uniqueness of an item of supply through a Federal Item Identification, the identity of that item is fixed and its relation to other items established through the assignment of an NSN.

d. As of 1 October 1974, a 13-digit stock number consisting entirely of numerals is being assigned to items of supply. The term NSN is to be used for identification of the US 13-digit stock number in all materiel management functions. In logistics matters involving the NATO Headquarters or individual NATO countries, the abbreviation NSN shall be interpreted to mean NATO stock number. The NSN is composed of two groups of numbers. The first four digits are the Federal Supply Classification (FSC) code assigned to the item. The last nine digits are the National Item Identification Number (NIIN) of which the first two digits (reading left to right) are the National Codification Bureau (NCB) code. The NCB is used to identify the central cataloging office of the NATO or other friendly foreign country which assigned the item identification number (e.g., United States, 00 or 01; Canada, 21 etc.). These numbers are assigned as an item identification is approved, and there is no relationship between one NIIN and the next in sequence numerically. The random assignment of NIIN's has certain advantages. For example, it permits assignment during routine processing without the necessity for insuring that the number is in a particular class or group. Furthermore, when the status of an item changes, as in the case of transfer to a different class, there is no need to change the NIIN. The NIIN remains with the item as long as this item exists in a supply system, although the NSN will change if the item is changed from one

FSC class to another. The NSN system provides important advantages, such as—

Uniformity—In structure, composition, length, and use.

Stability—The National Item Identification Number lives with the item forever.

Adaptability—The NSN fits differing needs of supply management and operations and is compatible with existing and advanced mechanical, electrical, electronic data processing, and microfilm equipment.

Simplicity—It is applicable without modification to all items, easily maintained, and easily recognized.

e. The final basic element of the Federal Catalog System is the publication of the Federal Item Identification, related NSN, and corresponding logistics management and reference data for each item of supply, in order that this information may be made available to using and interested military activities and civil agencies. The governing directive, DOD 4130.2, specifies that standard microfiche, reduction ratio of 48x, shall be employed through the DOD, unless otherwise justified, to minimize printing and distribution costs associated with publication of the Federal Supply Catalog. The Federal Item Identification characteristics data are published and distributed by the DLSC on microfiche in the Federal Item Logistics Data Record (FILDR). The related logistics and reference data are distributed to Federal cataloging participants, including Army national inventory control points (NICP's). DLSC also publishes the Defense Integrated Data System (DIDS) Procedures Manual (DOD 4100.39-M) which contains operating procedures for the Federal Catalog System, as well as maintaining and publishing cataloging tools such as Federal Item Identification Guides (FIIG's) and the Cataloging Handbooks. The Defense Logistics Agency (DLA) maintains and publishes the Federal Catalog System Policy Manual (DOD 4130.2-M).

3-4. The Federal Supply Catalog

a. The Federal Supply Catalog is not a single printed book or a bound catalog. Rather, it is a vast array of master computer records stored in computers, one for each item in the supply system, which are maintained in one central location. Duplicate records are provided from this central location to various activities, but each organization is furnished only those records that apply to items for which they have recorded a managing, cataloging, or user interest.

b. Federal catalog data are distributed worldwide through the following publications maintained by the electronic data processing method to provide the greatest flexibility and control in operations. They

are distributed to Federal and other selected activities as required to meet varying operational needs and logistics interest. A general description of each publication is as follows:

(1) The introduction to the Federal Supply Catalog, C-1(A), is an Army publication that provides an official source for information applicable to Federal Supply Catalogs for customers within the Department of the Army (DA) requiring data pertinent to the preparation of requisitions, financial inventory accounting records, and related supply documents. In addition, it provides instructions for the use and maintenance of the Federal Supply Catalogs, Change Bulletins, and Change Notices. This publication is comprised of four sections as follows:

(a) Section I—Introduction.

(b) Section II—Identification List.

(c) Section III—Management Data List.

(d) Section IV—Master Cross-Reference List.

This catalog, disseminated in hard copy form, will be revised annually and will be maintained by cumulative change bulletins, as required.

(2) The IL is published in basic editions and related change bulletins for the purpose of providing timely item identification data for use by DOD, GSA, and civil agencies. The identification section of the IL contains characteristically described and/or reference number described items as applicable in FSC sequence and within FSC by item name. Beneath each item name, characteristically described items are listed first followed by reference number described items. Reference number described items are listed in NIIN sequence and presented in NIIN to manufacturers' reference and manufacturers' code number style. Reference Method Item Identifications reflect a maximum of three manufacturers' reference numbers. Security classified items will not be published in the IL. Also excluded from the publication are medical, Defense Nuclear Agency, subsistence, and National Security Agency managed items. The IL is published in basic editions and related change bulletins for the purpose of providing timely item identification data for use by the military services and DOD agencies. Basic IL editions and related change bulletins shall be distributed to reach all users at least 30 days prior to the publication effective date. Basic editions and related change bulletins are contained on microfiche.

(3) Master Cross-Reference List (MCRL) is a publication that contains a master list of NSN and Logistics Reference Numbers cross-referenced to each other.

(a) The MCRL, Part 1 and Part 2, is comprised of all reference numbers and NSN's registered in the DOD DLSC master cataloging file.

(b) MCRL, Part 1 (manufacturer's code and reference number to NSN), is designed primarily to

aid in identifying an item to an NSN when only a manufacturer and reference number are known.

(c) MCRL, Part 2 (NSN to manufacturer's code and NSN to reference number), is designed primarily for use by acquisition and technical research activities.

Four basic elements of data are provided in the MCRL: reference number, logistics; assigned NSN; Federal Supply Code for Manufacturers (FSCM); and Reference Number Variation Code (RNVC). Another data element, Service/Agency Designator Code, is sometimes shown in the RNVC column to explain a particular cross relationship of numbers. The MCRL also shows a cross-reference from superseded, transferred, and canceled-replaced stock numbers to current stock numbers and vice versa. The MCRL is produced and issued on DOD standard microfiche (48.1) in January and July of each year as basic editions. No intervening change bulletins will be used.

(4) The Management Data List (ML) (C-ML-A) is a publication containing military service management data necessary for requisitioning and accounting for items of supply. The ML provides elements of management data required by a military service in managing, procuring, stocking, and issuing items of supply within the Federal Cataloging System. The publication is arranged in NIIN sequence, preceded by the Federal Supply Class, and includes management data such as sources of supply, unit of issue, unit price, interchangeability and substitutability, etc., and is produced in military service tailored versions, composed of NSN's against which a specific military service is recorded as a user. Basic editions and change bulletins will be cumulative in that each will contain all changes, additions, deletions, or reinstatements that have occurred since the publication of the preceding basic edition. The ML is produced on standard microfiche at a reduction ratio of 48.1. Basic editions are produced quarterly with monthly cumulative change bulletins between basic editions, unless otherwise directed by the program manager. A new basic C-ML-A is produced and distributed monthly by DLSC.

(5) The DOD Ammunition Code Publication (SB 708-30) contains the DOD Ammunition Code (DODAC) numbers that are assigned by DLSC to generic descriptions submitted by activities within the DOD. The DOD Ammunition Codes are published in basic editions only on standard 48.1 microfiche on a quarterly basis. The publication is divided into two parts as follows:

(a) *Part 1.* An alphabetic list of approved item names that pertain to ammunition and guided missiles, except repair parts and industrial components, to which DODAC's have been assigned. Several items of supply, each having the same item

name and each being functionally interchangeable (and are, therefore, treated collectively in normal supply operations) are listed beneath the common item name.

(b) *Part 2.* An alphanumeric list by FSC class, of the last four characters of the Ammunition Codes contained in Part 1.

c. The sets, kits, and outfits Components List (CL's) is an Army publication that lists the items which comprise a set, kit, or outfit. The CL's are published by the Army activity having the predominant interest in the set, kit, or outfit.

d. The publication published by the DLA through the DLSC are the basic operating manuals of the Federal Catalog System and contain the operating rules and procedures covering the development and maintenance of a uniform catalog system. The CL's are compiled by the Army activity having the predominant interest in the set, kit, or outfit and published from ACL's publications data bank.

(1) *Defense Integrated Data Systems Procedures Manual, DOD 4100.39-M.* This is the basic operating manual of the entire cataloging system the volumes and titles are listed below.

(a) Volume 1. General and Administrative Information.

(b) Volume 2. Multiple Application Procedures.

(c) Volume 3. Development and Maintenance of Item Logistics Data Tools.

(d) Volume 4. Item Identification.

(e) Volume 5. Data Bank Interrogations/Search.

(f) Volume 6. Supply Management.

(g) Volume 7. Establish/Maintenance of Organizational Entity and Provisioning Screening Master Address Table.

(h) Volume 8. Document Identifier Codes (fixed length).

(i) Volume 9. Document Identifier Codes (variable length).

(j) Volume 10. Multiple Application References/Instructions/Tables and Grids.

(k) Volume 11. Edit/Validation Criteria.

(l) Volume 12. Data Element Dictionary and Glossary of Terms/Acronyms.

(m) Volume 13. Materiel Management Decision Rule Tables.

(n) Volume 14. Reports and Statistics.

(o) Volume 15. Publications.

(2) *Federal Supply Classification (H2 series).* The FSC is a commodity classification system that utilizes a four-digit coding structure designed to serve the multiple functions of supply. The FSC system, and its published indexes, have been developed for use in grouping related items of supply in the Federal Catalog System. The four-digit FSC class

also appears in the first four positions of each NSN. It is published in three parts.

(a) *Part 1, Groups and Classes (Cataloging Handbook H2-1) (SB 708-21)*. A numeric listing of the FSC structure plus the title and general coverage of each group and class in the four-digit FSC code numbering system. Main inclusions, and exclusions, which delimit the coverage of a particular class, are shown. Basic editions are published on microfiche and issued on a quarterly basis intervals.

(b) *Part 2, Numeric Index of Classes (Cataloging Handbook H2-2) (SB 708-22)*. A numeric listing of all FSC classes, with the name of items and commodities arranged alphabetically within each FSC class. Basic editions are published on microfiche and issued on a quarterly basis. The FIND contains approved item names (AIN's) and general item names with appropriate cross-reference.

(c) *Part 3, Alphabetic Index (Cataloging Handbook H2-3) (SB 708-23)*. An alphabetic listing of all the names of items and commodities included in Part 2, with each name referenced to the applicable four-digit FSC class code number. Basic editions are published on microfiche and issued on a quarterly basis.

(3) *Federal Supply Code for Manufacturers (H4-series)*. The Federal Supply Code for Manufacturers (FSCM) is a comprehensive listing of the name and address of manufacturers which have supplied or are currently supplying items of supply used by the Federal Government, and the applicable five-digit code assigned to each. The FSCM is used in supply management, automatic data processing, and other functions within the Government where a uniform length, numerical code for the complete name and address of manufacturers is required. Published in three parts.

(a) *Part 1, Name to Code (United States and Canada) (Cataloging Handbook H4-1) (SB 708-41)*. An alphabetic listing of names of manufacturers in the United States or Canada, with each name referenced to the assigned five-digit code. Related historical and affiliation data are shown. Published as a basic edition only on a bimonthly basis.

(b) *Part 2, Code to Name (United States and Canada) (Cataloging Handbook H4-2) (SB 708-42)*. A numeric listing of the five-digit codes, with each code referenced to the manufacturer in the United States or Canada to whom it has been assigned. Related historical and affiliation data have been omitted. Published as a basic edition only on a bimonthly basis.

(c) *Part 3, FSCM (excluding the United States and Canada) (Cataloging Handbook H4-3) (SB 708-43)*. This publication, which only includes codes assigned to manufacturers with ad-

dress outside of the United States and Canada, consists of three sections:

1 *Section A*. An alphabetic listing of the names of manufacturers, with each name referenced to the applicable five-digit numeric and/or five-symbol North Atlantic Treaty Organization (NATO) codes.

2 *Section B*. A numeric listing of the five-digit codes, with each code referenced to the manufacturer to whom it has been assigned, and to its related five-symbol (NATO) code, if any.

3 *Section C*. An alphanumeric listing of the five-symbol (NATO) codes, with each code referenced to the manufacturer to whom it has been assigned, and to its related five-digit code, if any. Published as a basic volume and maintained by quarterly cumulative supplements. Revised and reprinted at approximately 2-year intervals.

(4) *Federal Item Name Directory (FIND) (H6 series)*. The FIND for supply cataloging contains item of supply names with definitions, item name codes, and other related data required to prepare item identifications for inclusion in the Federal Catalog System. Published in three sections.

(a) *Section A, Alphabetic Index Names (SB 708-6A)*. Basically, this index is used as a dictionary of item names and includes definitions, item name codes, etc. Published as a basic edition only on a quarterly basis.

(b) *Section B, Federal Item Name Directory of Supply Cataloging (SB 708-6B)*. This publication consists of two subsections:

1 *Subsection 1, Numeric Index of Item Name Codes to Federal Item Identification Numbers and Federal Item Identification Guides*. This index is used as a cross-reference list to determine the item name and FIIG to use when the item name code is known.

2 *Subsection 2, Alphanumeric Index of Federal Item Identification Guides to Item Name Codes*. This index is used as a cross-reference list to determine the item name codes included in the coverage of each FIIG. Published as a basic edition only on a quarterly basis.

(c) *Section C, Abbreviations and Symbols (SB 708-6C)*. This index contains three subsections: Subsection 1, Terms Referenced to Authorized Abbreviations; Subsection 2, Authorized Abbreviations Referenced to Terms; and Subsection 3, Symbols.

(5) *Manufacturers Part and Drawing Numbering Systems (H-7) (SB 708-70)*. This handbook is designated "For Official Use Only." This designation limits distribution to Government civil agencies and military activities only.

(6) *Federal Supply Code for Non-Government Organizations (H8 series)*. The Federal Supply Code for non-Government organizations is a five-position

numeric or alphanumeric coding structure assigned to business establishments which are not manufacturers or are manufacturers that do not meet the criteria for inclusion in the FSCM Handbooks (H4 series). These non-Government organization codes serve as a standard contractor identification system for distributors, service organizations, wholesalers, which is required for participation in Military Standard Contract Administration Procedures (MILSCAP) and ADP systems. Published in two parts with each part divided into two sections: Section A, includes Cancel and/or Replacement entries; Section B, Includes Current and/or Obsolete entries.

(a) *Part 1, Name to Code (United States and Canada) (Cataloging Handbook H8-1) (SB 708-81)*. An alphabetic listing of the names of business establishments referenced to their assigned five-digit code. Related historical data are shown. Published as a basic edition only on a bimonthly basis.

(b) *Part 2, Code to Name (United States and Canada) (Cataloging Handbook H8-2) (SB 708-82)*. An alphanumeric listing of the assigned five-digit codes referenced to the applicable names of business establishments. Related historical data shown in Part 1 are omitted in Part 2. Published as a basic edition only on a bimonthly basis.

e. Although all items of supply used on a repetitive basis by all agencies of the Government are included in the catalog, items are continuously moving in and out of the catalog. Obsolete items and items no longer in demand are replaced by new or replacement items.

f. The Federal Supply Catalog, as an operating source of information, has been of great benefit to the Defense Standardization Program and the Defense Provisioning Program. The catalog system has provided the means by which both of these programs are maintained, not only for economic reasons, but also for effective utilization of materiel resources. The existence of the catalog in itself serves as a monitoring effect on the programs as discussed briefly below.

(1) *Defense standardization program.*

(a) Standardization is simply the process by which the DOD achieves the closest practicable cooperation among the services and defense agencies for the most efficient use of research, development, and production resources, and by which it agrees to adopt, on the broadest possible basis, the use of—

1 Common or compatible operational, administrative, or logistics procedures.

2 Common or compatible technical procedures and criteria.

3 Common, compatible, or interchangeable supplies, components, weapons, or equipment.

4 Common or compatible technical doctrine with corresponding organizational compatibility.

A product is deemed to be standardized when it conforms to specifications having the same technical requirements.

(b) The purpose of the standardization program is to reduce the number and types of items that the military services supply to their forces. Activity in attaining the objective of standardization is carried out during the research and development process and is performed continuously while items are in the supply system. The term thus applies to the duties performed and the end result of such actions. In the broadest sense materiel standardization reduces unnecessary varieties of similar things that serve a specific purpose.

(c) The DOD Standardization Program is concerned with items of supply and with materiel, processes, and practices used in their production, acquisition, and maintenance. It exists primarily to provide effective materiel support to the Armed Forces in terms of the most efficient single item to meet each requirement, instead of a variety of similar and less efficient ones. Its goal is an ultimate lean, strong supply inventory consisting only of items required to support operating forces at peak proficiency. Standardization also contributes to the saving of dollars by using standard items in design and engineering and by acquisition under specifications commonly used by all military departments. The use of common technical specifications is enhanced by this program. Common use of published specification for the acquisition of hundreds of thousands of items by the military services and the DLA reduces the acquisition costs for the Government by more than 10 million dollars a year.

(d) By the very name given to the act, Congress indicated the function of standardization to be equal in importance to cataloging in overcoming the supply ills of the past. Cataloging was to identify materiel, standardization was to increase the efficiency of materiel and streamline the inventory. Congress assigned the Standardization Program to the Secretary of Defense who then delegated control to the DLA. Each department of DOD has a Departmental Standardization Office the Army's being the Commander, DARCOM. The organizations having assigned responsibility for FSC classes plan and manage standardization and the personnel in Army readiness commands and DLA Centers coordinate with users of their materiel in actual performance of standardization. The DLA coordinates the assignment of Federal Supply Classes to the military departments in conjunction with their standardization responsibilities.

(e) The Defense Item Entry Program, as an adjunct to the Defense Standardization Program operated by the DLA, is designed to preclude the entrance of duplicate items into the system. This pro-

gram is controlled by the DLSC and monitors, specifically, the entrance of items into high-growth FSC classes.

(2) *The provisioning program.*

(a) Provisioning, like standardization, has a great impact on all of the managerial functions. It is neither a new technique nor method of operation. The Army's equipment will only travel so far or operate just so long before a repair will be needed. If the principles of initial provisioning are followed, tools, repair parts, and necessary equipment to do the job will be on hand. If not, materiel readiness, so far as the particular item is concerned, is meaningless. Basic planning for provision of sufficient materiel to support an end item during an initial period of operation is performed during the research and development phase of supply management, prior to introduction of the item into the system. The coordination between developing and cataloging activities to insure timely repair parts support is of utmost importance. Due to the wide variety and complexity of equipment entering the supply system, it became increasingly apparent that an improper balance of tools and parts could impair maintenance, supply, or mobility. A certain amount of repair parts of support of these sophisticated weapons should be immediately available, but the question was "how much?" today's Army must be mobile. Too little might mean excessive deadlining of equipment; too much would require transportation of burdensome stock.

(b) In recognition of the impact of these significant factors, the Secretary of Defense directed, in 1956, that even greater emphasis be given to improving the effectiveness and economy of maintenance operations within each military department. A review of provisioning methods was ordered, data on failure rates and the system for reporting such data were modified as necessary, maintenance facilities were consolidated, and uniform criteria and standards were established for repair, overhaul, and rebuild as a basis for efficient provisioning. AR 700-120 established the Secretary's "Policy and Principles Governing Provisioning of End Items of Materiel" in accordance with the objectives of earlier maintenance engineering directives and formally related provisioning and maintenance engineering to eliminate unnecessary varieties of equipments, components, and parts. Whenever an item is to be given an NSN, the NICP provides necessary information for cataloging to the DLSC. This type information, available on items in the system, is later used in the central provisioning screening process whereby items to be procured are first matched with existing standard items to preclude duplication.

(c) The fact that rapid advancements in technology require changes in components of end items even during the development stages also received Secretarial attention. Investigation resulted in directions that phased provisioning would be applied to selected high-cost items that were either new to the DOD inventory or were undergoing major modification. This refinement of the initial provisioning process permits an arrangement with manufacturers for an increased production inventory to be held by them as a buffer stock to satisfy demands on the supply system.

g. Through the use of the Total Item Record (TIR) and its attendant System Support Record (SSR), which is maintained by the DLSIE in Battle Creek, Michigan, and the computer processing techniques now available at most inventory control points, an inventory manager has access to management data on any of the more than 4,500,000 NSN's in the catalog. Manufacturer's part numbers and codes can be matched to the appropriate NSN. If, in the buying process, a part number or manufacturer's code is available, it is possible to submit this information to DLSC in card format as prescribed in DIDS procedures manual by mail or AUTODIN to determine if an NSN is available. If it is available, additional management data can be provided. This information, which is maintained and updated in the computerized Master Catalog File, includes for each item—

- (1) Federal supply class.
- (2) Manufacturer's number and code.
- (3) Item name and code.
- (4) Standardization status code.
- (5) Acquisition status (acquisition method).
- (6) Activity with inventory management responsibility.
- (7) Specification and standards data.
- (8) Acquisition sources.
- (9) Kind of match code.
- (10) Acquisition method code.
- (11) Acquisition method suffix code.
- (12) NIIN status code.

This process of "matching" and "cross-referencing" is essentially a screening process which prevents duplication of cataloged items and facilitates the control of the number of NSN's assigned.

h. All catalogs, both the Federal and DA, contain item intelligence utilized for effective materiel management and related functions including the requisitioning of items. They list items that are centrally managed and which may be stocked or nonstocked and centrally or locally procured. Management decisions which create changes in the item intelligence published in the catalogs result in changes being published as supplements to the basic catalog.

Section II. INTRODUCTION OF NEW EQUIPMENT/ITEMS

3-5. Entry of New Items

a. Materiel Suitability

(1) The research and development commands, the materiel readiness commands, and the Test and Evaluation Command of DARCOM are engaged in the development and testing of advanced equipment. Each materiel readiness command is responsible for research and development of materiel in the groups it manages and all of these commands are required to coordinate with each other and with other DOD agencies in the development of materiel to insure each new item is suitable for issue. The inclusion of quality and performance characteristics is an essential element of the wholesale materiel management mission of DARCOM. The entry of new items into the system is generally the result of research and development effort in devising newer or better materiel in support of combat needs.

(2) The term "new item" for the purpose of this discussion, covers all principal Procurement Appropriation Army items and all secondary (Operation and Maintenance, Army (OMA)) and Stock Fund (SF) items that are newly type classified and are—

- (a) Being produced and introduced into the Army supply system for the first time; or
- (b) Are being produced by a new producer for the first time.

Procurement Appropriation funds are used primarily to procure major items, and stock fund monies generally procure secondary items. By DARCOM regulation, suitability must be insured on either type item that is subject to engineer or service testing during the development cycle. All test and evaluation effort must be expanded and all deficiencies must be corrected (or planned for correction by modification or post-issue action). The Test and Evaluation Command concurs in the adequacy of the testing program; the readiness command states that the materiel has no known deficiencies that will not be corrected, and only then is authority requested of DARCOM to issue materiel.

b. Screening.

(1) Before a new item can be entered into the Federal Catalog, provisioning planning, documentation, and compliance with standardization and item entry principles insure, by a comprehensive screening, that each item being entered differs significantly from every other cataloged item. Item control, therefore, begins with effective identification and cataloging under the Federal Supply Cataloging System. The DLA has established the DLSC which manages the complete mechanized Federal Catalog. The DLSC has developed a screening program in collaboration

with the military services to match proposed new items against existing standard items already in the system.

(2) When a new end item of equipment is being developed and tested, the components or special tools required to support an end item, as well as the end item itself, receive screening for related cataloging actions. The procuring activity requires that the contractor who is producing the item submit a list of all components and tools needed for support. The listing provides the manufacturer's part number, a description, and any other management data that may assist in screening against existing Federal standard items as explained in paragraph 3-4. From this list the readiness command personnel select those items that they agree to be necessary, decide on quantities required, and make determinations to catalog those items not currently in the supply system. Descriptions are written and NSN's are secured as required. The requirement for early publication of catalogs and technical manuals is often the basis for erroneous entry of duplicate items. If a short deadline is imposed and insufficient time is allotted for a systematic search, the cataloging activity may perform only a local review of known items without referring the item to DLSC for screening. Long after the item is cataloged and stocked, a program to reduce the overall inventory may reveal a duplication which occurred because the cataloger was not allowed to perform his function efficiently due to time restrictions. Each cataloging activity is furnished microform records and/or magnetic tapes by the DLSC of items in the classes that are managed by their agency. The portion of the catalog available within the agency is usually checked first, followed by screening against the master data at DLSC prior to actual cataloging action. Matching of part numbers to NSN's during screening against central files prevents preparation of unnecessary item identifications and eliminates the possibility of multiple NSN assignment.

c. Provisioning.

(1) The purpose of provisioning is to insure the timely availability of minimum initial stocks of support items and associated technical documentation at using units and support units to sustain the programmed operation of systems and end items for an initial period of time, until the demand support system can take over supply responsibility.

(2) Whenever possible, provisioning is begun prior to the production contract because of the need for identifying and selecting those parts, tools, and equipment needed to support service testing and troop testing, long before maintenance programs or even design configurations are firm. When preliminary selection of tools or parts is made, source, main-

tenance, and recoverability coding is frequently accomplished which, after necessary modification, becomes firm data for publication in catalogs and technical manuals. The selection and coding of items is accomplished during an initial provisioning conference attended by personnel of the developing agency and the manufacturer, using the listing supplied by the producer, referred to above, in screening proposed materiel against already cataloged items.

(3) During the provisioning conferences, the maintenance engineering activity of a materiel readiness command specifies which items require NSN's. Concurrently, the contractor is advised as to those items for which the Government will obtain item identifications. This is accomplished in accordance with AR 700-18, "Provisioning Requirements for US Army Equipment."

d. Commercial Items. So far we have considered item entry as occurring through the research and development (R&D) process. It often happens, however, that a commercial item is found that meets a military need. In such a case an item description is written, a stock number is secured, and steps are taken to enter the item into the catalog, into authorization documents, and into technical manuals. In fact, the DOD policy of this subject states that "whenever feasible, military operational requirements for materiel shall be satisfied through the use of existing military designs or commercial products." Each major agency having development control of materiel takes classification action on every item entering the system, recording its status from the standpoint of development and suitability for service use. Those major items which are available from commercial sources and do not require R&D action are type classified and formally entered into the system by action of a technical committee. When entry is the result of R&D action, type classification is processed by the agency having development responsibility. When a commercial item is type classified, the agency having or proposing logistics responsibility takes the action. Type classification has an impact on future management of an item, which is examined in "Impact of Cataloging." As one example, however, the majority of materiel bought by the Army is type classified, and restrictions are stringently applied as to the type and amount of funds which can be utilized in such buying. Any activity requesting that an item be assigned an NSN is, in reality, expecting that the item will be stocked in and supplied from the Army supply system. It is impossible to stock, maintain, and issue every item that the Army needs; AR 71-1 specifies that type classification is not required for commercially available items whose sole basis of issue is a Table of Allowance or a special requirement if there is no significant quantitative Army requirement for the item. There must first be a positive

requirement for an item before a request for an NSN is made. The fact that it is believed an item should be in the system is not enough.

e. Personnel engaged in a provisioning activity during the development process are beset by problems within problems. While attempting to save money, get quality equipment, manuals, and parts produced and distributed as quickly as possible, they are subjected to sudden shifts that disrupt the entire pattern of progress. Funds may be curtailed; programs may be compressed to secure earlier delivery of an urgent item. One point, however, should not be overlooked. While R&D personnel are engaged in forging better weapons and equipment they are, at the same time, forging the tools and materiel management. All of the documentation submitted by contractors, whether it be provided on electric accounting machine cards, a provisioning list, or tapes will, when refined, be incorporated into technical manuals or catalogs used in continuing management of the item.

3-6. Technical Committee Action

a. The technical committee can be described as the formal point of contact between the people who develop or introduce items into the Army system and those who manage it thereafter. Major events or milestones are recorded during the development process and coordinations that influence later management of an item of supply and arranged between engineering, maintenance, and future managers. The ultimate decision of the technical committee to enter an item into the supply system constitutes formal Army Materiel Development and Readiness Comments of the Army concerned with the item must concur in decisions that become the basis for entry into catalogs, manuals, and bulletins. The actions of a technical committee result in expeditious coordination, in approval, and in recording of actions and decisions. A technical committee is established and maintained by the chief of each developing agency to effect the necessary coordination among developing and using agencies during research, development, test, and type classification phases.

b. Overall supervision of the technical committee system within the Army is exercised by the Chief of Research and Development who develops the Army General Staff position on all formal actions placed before technical committees and takes Army General Staff action to resolve any nonconcurrences. He approves actions and proceedings of technical committees contained in the minutes of meetings. The US Army Materiel Development and Readiness Command (DARCOM), the Office of the Chief of Engineers, the Office of the Surgeon General, and the US Army Electronics Materiel Readiness Activity (EMRA) sponsor technical committees and are

known as parent agencies. Technical committee meetings are held at least once per fiscal quarter on dates mutually acceptable to the parent agency and the Army General Staff (except for the EMRA Technical Committee, which meets at least once per fiscal year). The committee chairman must notify all committee members, observers, and other interested agencies of the dates and agenda of meetings. Each parent agency is authorized to establish and maintain a technical committee with such subelements as necessary to meet the requirements of the command. Parent agencies prescribe operating procedures for their own technical committees, designate representatives on technical committees established by other parent agencies, establish records which furnish a comprehensive history of each R&D project and item of materiel, review the results and publish and distribute technical committee minutes within 30 days after a meeting.

c. Technical committees are composed of the chairman and the other representatives of the parent agency, the representative of the Secretary of the Army and the Army General Staff (provided by the Chief of Research and Development), representatives of the Combat Developments Command, other Army developing agencies, and a representative of the US Army Communications Security Logistics Activity if items are included on the agenda that are of interest to that command. The manager of the bulk of Army materiel, DARCOM, is the Army major parent agency. It has one technical committee located in its Washington headquarters with technical subcommittees having assigned responsibilities relating to specific items, groups of items, or systems. The DARCOM Technical Committee (DARCOMTC) is composed of one voting member each from—

- (1) US Army Materiel Development and Readiness Command.
- (2) Office of the Chief of Research and Development, DA (representing the Secretary of the Army and the Army General Staff).
- (3) Forces Command.
- (4) Office of the Chief of Engineers.
- (5) The Surgeon General.

Technical committees receive requests for action from using, developing, and supporting agencies. The majority of submissions, are generated by developing agencies, though any agency can propose that an item be entered into the system (as for instance a commercial item). All proposed technical committee actions are completely coordinated within the preparing agency. Items to be included in the agenda of the DARCOMTC must be transmitted through, and be approved by, the technical subcommittee. Upon approval the agenda item is entered on the DARCOMTC agenda.

d. The technical committee takes either a formal or a read-for-record action, dependent on the extent of coordination or approval required. A formal technical committee action is taken on project initiations, approval of technical characteristics, changes in DA priorities, etc., which require concurrence of all interested members of the technical committee or require approval of higher authority. A read-for-record action is a recording of staff decisions taken on those matters that warrant recording but do not require the concurrence of all interested agencies nor approval of higher authority. The technical committee meets and makes decisions which are recorded. Minutes of the meeting, giving disposition of each agenda item, are furnished to all interested agencies for necessary action.

e. Technical committee decisions influence management of an item of supply all during its life cycle. The approved technical characteristics of an item under development may well determine ease of maintenance. Changes in dates of type classification may result in another procurement of an already existing item (scheduled for replacement) to insure continued materiel readiness until the new item is finally accepted and becomes available. Actions of technical committees can, and often do, mean that stock numbers or nomenclatures will change. They may mean that logistics transfers will occur from one class to another or even from Army to DLA for management. When these actions take place, all changes in manuals must be coordinated, for they are authority for—

- (1) Entry of a new item into catalogs.
- (2) Changes to cataloging data of existing related items.
- (3) Entry of the new item in SB 700-20 (Army Adopted Items of Materiel and List of Reportable Items).
- (4) Entry in authorization documents so that those having a requirement may requisition or procure the item.
- (5) Entry into technical manuals (if the item type classified has application to many end items the number of technical manuals requiring change may be numerous).

f. Cataloging information can only be provided by the service that generates equipment. This information is furnished to the technical committee and, after approval, action to enter an item into catalogs and manuals is taken by managers at Army NICP's. Army class managers in Army support commands take similar action for items of Army interest that are the integrated management responsibility of the DLA.

3-7. Army Cataloging

a. The procedures governing operation of the Army Master Data File (AMDF) are contained in Army Regulation 708-1. The AMDF is an automated system which encompasses management data authorized for use by the Army. This file is the source for extraction of data to provide selected item data elements most commonly used and required by field activities. The data are disseminated through microform products such as the Army Master Data File Retrieval Microform System (ARMS), the Supplemental Interchangeable and Substitute Items List (SISIL), and the Master Data Record (MDR). The US Army DARCOM Cataloging Activity (CDA) is designated as the single distribution point of current catalog and related logistical data to CONUS and oversea activities. The CDA maintains a composite AMDF from data submitted monthly on items managed by NICP's, Army class managing activities for DLA/GSA items, US Army Communications Security Logistics Activity, Electronics Materiel Readiness Activity, and US Army Medical Materiel Agency. The CDA disseminates an AMDF change notice worldwide to authorized recipients by magnetic tape or EAM cards once a month.

b. The AMDF is adaptable to ADP equipment and it provides data on all principal items, major items, secondary items, and repair parts that are the logistics responsibility of each command. It is described in Chapter 7, AR 708-1, which contains the 12 sections listed below with a summary of their purposes.

(1) *I—Procedures.*

(2) *II—Special Instructions.*

(3) *III—Item Data Segment.* One data record by NSN prepared by the item manager which provides and disseminates current and related logistics data required at various levels of supply management, financial accounting, acquisition, and preparation and routing of requisitions.

(4) *IV—Item Identification Segment.* A record prepared and maintained for all NSN's recorded in the Item Data Segment. The purpose is to provide nomenclature (abbreviated or extended) for use in the preparation of Army stockage lists (ASL's), DA supply catalogs, supply bulletins, and adopted items list.

(5) *V—Packaging Segment.* Provides details of cleaning, preserving, and packaging an item or it will refer to the packaging data sheet, specification, or instructions which contain the needed data. This is prepared by the item manager and the data are maintained for an NSN recorded in the Item Data Segment.

(6) *VI—Freight Segment.* Freight classification records are prepared by the item manager and used for CONUS activities to determine rates and modes of routing for materiel shipments within

CONUS. An Item Data Segment record must exist at CDA before a freight record can be established.

(7) *VII—Interchangeable and Substitute (I&S) Segment.* Provides a means for recording and distributing approved I&S data for identifying items and for identifying those NSN's in FSC group 13 assigned a DODAC. For recipients of the data it serves to satisfy requirements, defer requisitioning, and reduce unnecessary purchase by utilizing available assets.

(8) *VIII—Reference and History Segment (REFHIS).* This segment is comprised of three sections: Item Data History, Interchangeable and Substitute History, and Component History. It shows all current and/or former identifying numbers ever assigned to an item of supply.

(9) *IX—Component Segment.* Provides a means for recording, maintaining, and distributing data for NSN's to which Phrase Code M or Q has been assigned.

(10) *X—Equivalent Item Segment.* Identifies equivalent items, assigned Phrase Code Y, that can be used to meet demands if required item is not on hand, and to furnish information on items with identical physical and performance characteristics but differing in unit quantity and/or unit of issue. Defers requisitioning when an equivalent item can be used in lieu of a required item.

(11) *XI—Code Data.* Specifies codes used in the AMDF such as, error, phrase, price signal, acquisition advice, etc.

(12) *XII—Automated Inquiry/Reply System.* Provides a uniform method for securing management data information from the AMDF at USA CDA. Provides a record image of the various segment(s) of the AMDF, provides for querying the AMDF for a specific range of data elements extracted from a combination of AMDF segments furnished by NSN only, or provides the inquirer the capability of validating a selected range of supply data pertinent to this system by NSN only.

3-8. Impact of the Cataloging Function

a. *Magnitude of Cataloging Services.*

(1) The Federal Catalog System currently serves the catalog needs of six Defense Supply Centers, 54 departmental inventory managers, and numerous other DOD managers, including the National Security Agency, the Defense Atomic Support Agency, and the US Coast Guard, for a total of 60 wholesale and retail materiel managers in the DOD.

(2) The system also serves 79 inventory managers among the civil agencies. In addition, DLSC is responsible for coordinating NATO and friendly foreign nation participation in cataloging operations. This participation is increasing steadily. The

NATO nations have adopted the US system of supply classification and manufacturers' codes as the NATO Supply Classification and the NATO Supply Code for Manufacturers. There are currently 11 NATO countries, five other friendly nations, and two NATO agencies being furnished cataloging services.

(3) As of 1 June 1978, there were 4,765,300 NSN's representing active items of supply recorded in cataloging files at DLSC. The files also contained 514,372 item identifications in an inactive status (without recorded managers). Item identification requests from participating activities are screened in a single processing cycle against both active and inactive identifications in the total file of 5,279,672 items. The matching of incoming new submittals (requests for NSN assignment) against inactive identifications makes possible the reactivation of some inactive numbers thus avoiding the assignment of new NSN's. Of the 4.4 million items recorded in the files, 3.7 million items are managed by the DOD. There are over 300,000 items used only by the civil agencies and 400,000 used only by NATO.

b. Federal Items Identification Guides (FIIG).

(1) The Federal Item Identification Guide is designed to give the catalog system increased information, more accurate data in a more expeditious manner. This increased amount of descriptive information will do much toward preventing the assignment of several stock numbers to the same item of supply.

(2) A "FIIG" is a document which contains a list of questions, plus rules and guides, that are necessary to establish adequate descriptive and supply management data for each item of supply. It is designed to collect information required for multiple logistics purposes such as cataloging, packaging, provisioning, procurement, transportation, materiel utilization, and disposal. The FIIG was developed to include additional requirements recommended by engineers, procurement, cataloging, standardization, and supply specialists to satisfy their particular technical needs. A FIIG is a comprehensive, self-contained document consisting of general item information, three sections of data requirements, and appendixes as required. Simply stated, the use of a FIIG provides a complete package of data for each item of supply.

(3) Section I is designed to contain item characteristics data which are required to differentiate items of supply for purposes of NSN assignment.

(4) Section II is designed to contain data range values for the elements listed in Section I. These

values provide a manual or mechanized means for determination of item identity or interchangeability and substitutability relationships based on technical, functional, or physical characteristics. Data groupings, tables, measurements, tolerances, etc., may be provided to assist in determining selection of the reply to requirements in Section I.

(5) Section III is designed to contain supplementary technical data and management data which do not affect the assignment of NSN's, but which are necessary to support specific logistics functions.

(6) There are appendixes to each FIIG as required to make it a self-contained document. These appendixes are composed of MILSTICCS reply tables, reference drawings, and a functional and operational index. An integral part of the Federal Item Identification Guides is a system for coding the data shown in a FIIG. It is called "MILSTICCS," a short title for Military Standard Item Characteristics Coding Structure. It was developed as a uniform coding structure to solve the problems of increasing the responsiveness of the catalog system both in speed and volume, to prevent the entry of unnecessary items, and to facilitate the mechanization of logistics data.

(7) FIIG's and MILSTICCS are the tools used to collect the massive quantity of characteristics data to achieve the objectives of mechanization which has long been the goal of the Federal Catalog System.

c. Item Manager's Responsibility. Item managers (Primary Inventory Control Activity (PICA) and Secondary Inventory Control Activity (SICA)) are responsible for the assignment and correctness of the individual data management information/codes in the AMDF. The file is broadcast at the rate of one change per month effective the first day of the month.

d. US Army DARCOM Catalog Data Activity (CDA). The CDA is the proponent agency for the AMDF and is responsible for the control, interface of the AMDF with DOD/DA standard systems, and dissemination of logistics data changes to all levels of the Army wholesale and retail supply activities. The CDA Central Logistics Data Bank has the capability to provide AMDF data in one of the following modes:

- (1) Data set.
- (2) Segmented data.
- (3) Management data distribution.
- (4) Automated inquiry/reply data.
- (5) File extracts/special requests.

e. Utilization of Data. Army activities will utilize the data provided in the AMDF change notices to facilitate logistics functions and provide the data to supported logistics operations.

CHAPTER 4

MAJOR ITEM MANAGEMENT

Section I. GENERAL

4-1. Introduction

All military services give primary management attention to equipment and weapon systems such as aircraft, ships, combat tanks, and armament. The final decisions concerning such items normally are made at departmental or higher levels. In the Army these items are referred to as major items.

a. Major item management vs. secondary item management. For most major items, requirements and authorizations documents are approved by departmental headquarters. For secondary items, this is rarely the case. In this manner, a much higher level of control is exercised over the needs for the major items. Most materiel management consists of attempting to match assets (or materiel) to needs for the assets, and, in the case of major items, all assets including those in the hands of using units are matched to total worldwide needs. For secondary items, stock levels are matched to requirements for stock levels. For example, trucks are major items and, in materiel plans, total truck needs worldwide are compared to total trucks on hand in Army units and in depots worldwide. Truck engines are impor-

tant secondary items, and truck engines on hand in direct support units (DSU's) are compared to the needs of the DSU's for replacement engines for the operating fleet. However, every truck (major item) in the fleet is assumed to contain a serviceable engine (secondary item), and the installed engines are never included in materiel studies of truck engines.

b. Funding. Major items cannot be procured from industry until funds from congressional appropriations become available. The Office of Management and Budget (OMB) apportions these defense funds; the Office of the Secretary of Defense (OSD) releases the programs and funds; the Comptroller of the Army allocates the funds to the US Army Materiel Development and Readiness Command (DARCOM); and this command suballocates the funds to its materiel readiness commands, which are responsible for the acquisition actions necessary to obtain major items.

c. Control and visibility. Major items are issued only to fulfill approved authorizations. Reports are made of worldwide assets, including those assets in the hands of troop units and held for maintenance float, operational projects, and war reserves.

Section II. IDENTIFICATION

4-2. Introduction

Within the context of this manual, an item is determined to be a major item if it meets the following criteria:

a. The item requires centralized management and control of requirements determination, acquisition, overhaul, and disposal. To insure operational readiness, the Army needs centralized knowledge of distribution planned for each support level and of assets in the hands of claimants.

b. The unit value of the item is \$1,000 or more, or the total inventory plus programed acquisition exceeds \$900,000, or a budget line is required for the item. Each unit of this item is individually justified, authorized, and included in the budget at the departmental level.

c. The worldwide requirements for the initial issue quantities of the item are individually specified, computed, and programed by matching specific planned, programed, or current force structures with documents in the files of The Army Authorization Document System (TAADS) or with Tables of Organization and Equipment (TOE). The item is assigned class of supply code 4, 5, or 7 in Supply Bulletin 700-20.

d. The following selected items are designated major items (without regard for the preceding criteria):

- (1) All motorized wheeled and towed vehicles for use on either highway or rough terrain.
- (2) All weapon and missile end items.
- (3) All aircraft end items.

(4) All boats or ships with inboard power or all boats with a unit value of \$1,000 or more, whether with or without inboard power.

(5) All ammunition assigned class and supply codes will be managed under the major item management system.

(6) Selected class of supply of items, such as certain types of construction materiel, like shelters, are managed under the major item management system.

e. Any item not meeting the preceding criteria may be designated a major item on an exception basis. This action may be approved by DARCOM if the requestor is able to demonstrate convincingly that major item management procedures will result in better overall management than secondary item procedures.

4-3. National Stock Number (NSN) Assignment

The NSN is a unique number used to identify one specific make or model of major item. It is assigned by the Defense Logistics Services Center at the request of the managing command, which furnishes the necessary descriptive data.

4-4. Line Item Number (LIN)

The LIN is a code number used to identify the generic nomenclature which is used in requirements or authorization documents. This generic nomenclature identifies a need rather than a specific make or model, as does the NSN. Since requirements and authorizations are identified by LIN, and assets are identified by NSN, cross-reference data is needed to determine which makes or models of major item can be issued to satisfy the generic nomenclature found in the authorization documents. The needed data is published in Supply Bulletin 700-29, Army Adopted/Other Items Selected for Authorization/List of Reportable Items. NSN's may be matched to LIN's on a one-to-one basis; or, more than one NSN may be matched to only one LIN. In other words, several different makes or models of a major item may be suitable for issue to satisfy the generic nomenclature found in authorization documents.

4-5. Standard Study Number (SSN) System

Since there are about 8,000 different LIN's used in authorization documents, it is impractical for higher level managers to review each of them. As a result, the SSN system has been designed to provide a means of summarizing data pertaining to similar LIN's. The system contains a computer program which is used to consolidate the data for items such as 5-ton trucks with winch and 5-ton trucks without winch for study purposes. The system can also be used to summarize to the budget line level; e.g., 5-ton trucks,

all body types (which include truck-mounted missile launchers and other items mounted on 5-ton truck chassis). In addition, the SSN system contains a large data base consisting of the factors used in major item management, as well as other information listed in the subparagraphs below.

a. LIN. The six-character alphanumeric identification of generic nomenclature which is cross-referenced to equipment makes or models in Supply Bulletin 700-20.

b. Department of Defense Ammunition Code (DODAC). An eight-character alphanumeric identification of ammunition items as listed in Supply Bulletin 708-30.

c. SSN. An 11-character identification number used to indicate either a single LIN/DODAC or group of LIN's/DODAC's for which a materiel plan or distribution plan must be prepared.

d. NSN. A 13-digit number consisting of the applicable four-digit Federal Supply Classification (FSC) and a nine-digit National Item Identification Number (NIIN). The NSN is cross-referenced to the appropriate LIN by both the SSN system and Supply Bulletin 700-20.

e. Ratio. A five-position number used to indicate the number of major items which are included within another major item. For example, one truck is included in the NSN for a truck-mounted missile launcher.

f. Type item. A "primary" type item is an item which normally appears in requirements and authorization documents, such as the truck-mounted missile launcher. A "generating" type item is an item that creates or generates a requirement for a quantity of a primary item. The truck-mounted missile launcher is also a generating item in that a requirement for such a launcher also creates a requirement for a 5-ton truck, which itself is an item frequently listed in authorization documents. Assemblages and sets will not include major end items as components unless their installation/removal is so complex that it must be performed at depot maintenance level. Those major end items already included in assemblages and sets as components which do not meet this criterion will be authorized separately.

g. Reportable item control code (RICC). A one-digit numeric code assigned to selected items for readiness and asset reporting purposes.

h. Appropriation and budget activity account code. A one-position alpha or numeric code used to relate items to the applicable appropriations.

i. Type classification code. A one-digit alpha code indicating the type classification assigned the item (AR 710-61).

j. Logistics control code. A one-position alpha code used to provide a basis for logistical support deci-

sions, i.e., procurement, overhaul, repair parts provisioning, requisitioning, distributing, etc.

k. *Responsible Routing Identifier Code (RES RIC)*. A three-position alpha or alphanumeric code identifying the managing command.

l. *SSN nomenclature*. For any SSN with only one LIN/DODAC or with one primary type item, a maximum of 59 positions of the nomenclature appearing in Supply Bulletin's 700-20 or 708-30 is used as the SSN nomenclature. When two or more primary type items are to be summarized, a common nomenclature descriptive of the summary is selected.

m. *Operational readiness float (ORF) factor*. The ORF factor indicates the fractional quantity of the in-use mission-essential equipment needing or undergoing repair at the general or direct support level at any point in time.

n. *Repair cycle float (RCF) factor*. The RCF factor indicates the fractional quantity of the in-use mission-essential equipment needing or undergoing depot overhaul at any point in time.

o. *Unserviceable generation factor (UGF)*. The UGF indicates the monthly fractional quantity of the in-use equipment which will require depot overhaul. The UGF is actually an unserviceable return factor. It cannot be used to forecast total unserviceable generations, because data concerning major items which are placed directly into property disposal channels is not captured for purposes of UGF development. The UGF can, however, be used for maintenance

planning purposes as it does produce a total unserviceable generation figure available for overhaul/repair consideration.

p. *Peacetime replacement factor (PIRF)*. The PIRF indicates the fractional quantity of the in-use equipment which will become uneconomically repairable in 1 month.

q. *Wartime active replacement factor (WARF)*. The WARF indicates that fractional quantity of in-combat-use equipment which will require replacement because of projected intense wartime losses. Various rates are used for each 15- or 30-day period; 1-15 days, 16-30, 31-60, and so on.

r. *Overhaul condemnation factor (OCF)*. The OCF indicates that fractional quantity of the in-overhaul inventory which will be determined to be noneconomically repairable.

s. *Life expectancy*. This is the estimated useful life of an item. It is determined by experience with similar items, and considers both present conditions and probable future developments.

t. *Indicator codes*. These codes provide direction as to which items should be included in materiel or distribution plans, and the degree of summarization needed.

u. *Other codes*. A complete and more detailed listing of the codes used in the SSN system may be found in Supply Bulletin 710-1-1, Standard Study Number (SSN) Master File Cross-Reference Index.

Section III. MANAGEMENT AT THE NATIONAL LEVEL

4-6. General

Intensive management of major items at the national level is necessary because of their high-dollar value and combat essentiality. It is also necessary because of the impact that actions taken for major items have on related secondary end items and repair parts. The level of review given major items will differ depending upon criticality and total inventory dollar value. The most important items receive a final review by the OSD. Other items receive their final review at the Department of the Army (DA) Staff Level, particularly, the Deputy Chief of Staff for Research, Development, and Acquisition, the Deputy Chief of Staff for Operations and Plans, and the Deputy Chief of Staff for Logistics. Items of lesser importance are reviewed by Headquarters, DARCOM. Those of least importance are reviewed by the managing materiel readiness command. The funds for procurement of all major items are reviewed by the Comptroller of the Army.

4-7. Office of the Secretary of Defense (OSD)

a. *Consolidated Guidance*. The preparation of the annual Consolidated Guidance is the initial action

taken at the national level with respect to the determination of requirements for major items. It is issued by OSD to the Secretaries of the military departments, the Joint Chiefs of Staff, and the defense agencies. It contains guidance for force planning levels, fiscal levels, and materiel support planning.

b. *Joint Program Assessment Memorandum*. The Joint Chiefs of Staff prepare the Joint Program Assessment Memorandum based upon the fiscal and force guidance of the Consolidated Guidance. The Joint Program Assessment Memorandum, showing a summary of recommended forces and stating the impact of funds constraints, is then forwarded to OSD for their consideration.

c. *Army Program Objective Memorandum*. The Consolidated Guidance is also used by the military departments and defense agencies to prepare their Program Objective Memorandums. The Army's Program Objective Memorandum expresses total Army program requirements, providing force levels, manpower costs, and materiel recommendations for the budget year and the following 5 years.

d. *Program Decision Memorandum*. After OSD review of the Joint Forces Memorandum and the Program Objective Memorandums, the Secretary of

Defense issues to the services a tentative Program Decision Memorandum for their comments. After receipt and review of these comments, a final Program Decision Memorandum is issued by OSD to the military services and defense agencies. It provides general program guidance in the development of the Army Force Program. After appropriate modification to conform with this guidance and with a presidential dollar target, the first year of the Program Objective Memorandum actually becomes the basis for the annual budget.

e. Army Force Program. This program is used to aid in updating the 5-year defense program, developing the Procurement Appropriation Policy and Guidance, and preparing the Structure and Composition System (SACS) data.

4-8. Department of the Army

a. Deputy Chief of Staff for Operations and Plans. This staff element is the proponent for the SACS. The SACS is an automated process which matches Army units to their requirements and authorizations, thereby deriving the initial issue quantities needed by these units during mobilization and during peace.

(1) The force accounting system lists by unit identification code all of the Army Forces at the parent unit level (battalion or separate company). Included are actual units, programed units, and planned units, which are, respectively, units currently in existence, units which are programed for future existence, and units which are not programed for future existence, but which are needed when larger size forces are being studied. There are about 100 different data elements of management information associated with each unit—higher headquarters, location, readiness condition, etc.—but equipment requirements or authorizations by line item number are not included. The initial step in SACS processing is the extraction of those units in the Army Force Program, together with related management data, from the force accounting system. The SACS is the only source providing the approved Army Force structure with allowances and changes necessary to progress from the current through the budget and POM years. This force is restricted according to policy and ceiling limitations.

(2) The Army Authorization Document System lists, by unit identification code, all the equipment requirements and authorizations found in MTOE and in TDA. The second step in SACS processing is to match the units in the selected force with their requirements and authorizations, as stated in the documents under which they are organized.

(3) When future activation of Army units is programed, existing authorization documents may be unsuitable for a requirements projection. If this occurs, requirements and authorizations are de-

termined by matching the standard requirements code of the unit contemplated for activation with the appropriate (unmodified) TOE, as recorded in a computational file maintained by Headquarters, Department of the Army. This is the third step of the SACS processing.

(4) There are many new equipment items programed for introduction into the Army. However, the LIN's have not yet been incorporated into TOE's, TDA's, or MTOE's. Under these circumstances, a Basis of Issue Plan (BOIP) is developed and incorporated into the BOIP file. This file is simply a list of current LIN's and the LIN's of developmental items programed as their replacements. By matching the LIN's of the requirements and authorizations which have been recorded through the third step of the SACS processing with the BOIP file, the undesired LIN's are overlaid with developmental LIN's. This is step four of the SACS processing.

(5) In every automated system, there must be a means of including exception data. This is done through the shorthand notes file. It is useful for incorporation of last minute changes to the force list and the related requirements or authorizations, for input of data for new items when BOIP information is not acceptable or available, and for programed future revisions to MTOE.

(6) The final product of the SACS processing is the initial issue quantity (IIQ) needed by Army Forces for war (requirements) or during peace (authorizations). The data may be displayed by unit, in which case it becomes useful to commanders, or it may be displayed by LIN, in which case it is useful for national level management of requirements, authorizations, and assets.

b. Deputy Chief of Staff for Research, Development, and Acquisition. The Deputy Chief of Staff for Research, Development, and Acquisition uses the Program Objective Memorandum, the Army Force Program, and the OSD Consolidated Guidance to develop or revise its Plans and Policy Guidance, which applies to the Army's Procurement Appropriations and to the development of the Army Materiel Plan (AMP). The budget estimates, and the requests for apportionment of the congressional appropriations. This planning guidance includes such things as program cost breakdowns; production base data; and rules to apply in requirements computations. The Plans and Policy Guidance perpetuates the necessary portions of the OSD Consolidated Guidance.

c. Deputy Chief of Staff for Logistics. The Deputy Chief of Staff for Logistics uses the Program Objective Memorandum and the Army Force Program to develop or revise its Distribution Policy and Guidance Directive.

Section IV. THE ARMY ACQUISITION OBJECTIVE (AAO) AND THE ARMY MATERIEL PLAN

4-9. Introduction

The AAO is the target for peacetime acquisition of major items. It is that quantity of an item authorized for peacetime acquisition to equip the US Army-approved force in peacetime, and to sustain this force and specified allied forces from the start of a war through the period and at the level of support prescribed by the latest OSD Consolidated Guidance.

4-10. Gross Requirements

Determination of gross requirements is an intermediate step in the development of the AAO. Following is a list of the individual elements which, when added together, constitute gross requirements. The calculation of gross requirements is made for a given force structure without regard to the asset position. This means that gross requirements developed in this process do not represent the acquisition requirements, but rather they represent the total requirement for a major item to satisfy the needs of a given force level. It is necessary to consider the current assets plus the projected gains and losses in order to determine the acquisition needs.

a. Initial issue quantity. This is the sum of the quantities required by the units of the US Army-approved force to carry out their missions continuously in a wartime environment. The actual computation is made during the SACS processing, as described in paragraph 4-8a.

(1) A requirements document, the TOE, is developed for every different type of Army unit. It states mission, personnel, and the minimum essential equipment which military planners deem necessary for successful mission completion. The TOE serves as a pattern document to aid each unit in stating its own unique needs, by way of the modification TOE. The TOE is not the authority by which major items are issued. It is a planning document and is not used for authorizations. Proponent agencies are responsible for TOE design, change, and redesign. The TOE states equipment requirements at level 1, level 2, and level 3. The level 1 quantities represent the equipment needed by a unit to carry out its mission continuously in a wartime environment. Level 2 is approximately 90 percent of level 1, while level 3 is approximately 80 percent of level 1. The latest TOE data is incorporated into a computational TOE file maintained by headquarters, Department of the Army, for use in SACS processing.

(2) An authorization document, the MTOE, is fashioned by each Army unit using the basic or unmodified TOE as a pattern. It becomes a part of TAADS, and it is the authority for issue of major items. Changes are initiated by the unit, and may

be made in response to direction from higher headquarters or to locally recognized needs. When changes are approved by Headquarters, Department of the Army, the latest data is incorporated into their files for use in SACS processing. The MTOE displays a required quantity which is normally identical to the level 1 quantity of an unmodified TOE and expresses wartime needs. It also displays an authorized quantity, which represents the major items which the unit should currently have on hand or on order.

(3) Another authorization document, the TDA, states requirements and authorizations for Army organizations which hire civilians and which are not deployable during wartime. Examples are schools, depots, materiel readiness commands, etc. This document is very similar in concept to the MTOE. It is created by its designers in the organization, but there is no "pattern" TDA available for guidance during the design process. Data from TDA's are also incorporated into the files of TAADS at HQDA for use in SACS processing.

b. Operational readiness float (ORF). The ORF is a mission-essential major item needed for direct exchange purposes. It is maintained and stored in a serviceable, ready-to-issue condition by the supporting company and is available for unplanned and unprogrammed exchange with the using unit. When a unit experiences an equipment failure which cannot be diagnosed and repaired within prescribed time limits, the unit exchanges the unserviceable item for the serviceable ORF, so that a good operational readiness posture is maintained. ORF factors are determined by maintenance personnel and are entered into the files of the SSN system. The IIQ required for wartime, multiplied by the ORF factor, yields the number of major items needed for ORF during wartime.

c. Repair cycle float (RCF). The purpose of depot overhaul is to extend the useful life of equipment. The Army has equipment which must be overhauled periodically, based upon number of rounds fired, number of miles driven, number of flying hours incurred, or number of years in use. RCF provides Army units with new or overhauled equipment, so that the items needing overhaul can be returned to the supply system, can receive the necessary maintenance, and can then be used again as RCF. Major items used as RCF are normally stored where a depot overhaul capability exists; are made serviceable prior to exchange; and are used for planned or programmed exchanges. The IIQ required for wartime, multiplied by the RCF factor, yields the number of major items needed for RCF during wartime. The RCF factors are determined by maintenance personnel and are en-

tered into the files of the SSN system. The establishment and use of RCF will be controlled by HQDA and will be governed by funded and item depot maintenance programs.

d. Operational projects (OP). OP's are assignments to support specific logistical or contingency plans. If the IIQ's required by Army units contain insufficient equipment to adequately support the assigned OP, Headquarters, Department of the Army, incorporates a bill of materiel into the OP, thereby, approving the necessary materiel requirements. These requirements are then entered into an OP file maintained by the Logistics Systems Support Activity, or DARCOM organization located at Letterkenny Army Depot. However, not all OP's are authorized for inclusion into the gross requirements computation. Those which can be included are identified by the Deputy Chief of Staff for Research, Development, and Acquisition in the Plans and Policy Guidance, and are called "additive" operational projects.

e. Special contingencies. Specified quantities of equipment needed for supporting contingencies of allies.

f. Post D-day consumption. The quantity of major items anticipated to be lost in combat or worn out after the onset of war is identified as Post D-day consumption. These quantities represent requirements which must be included in the gross requirements computations, so that equipment will be available to replace those losses.

(1) *Combat consumption.* This is the quantity of equipment forecast to be lost under combat conditions. It is determined by multiplying a wartime loss factor by the number, in theater days, of major items planned to be engaged in war operations. The various rates provide for the intensity computation, and there is a rate for each 15-/30-day period; i.e., 1-15, 16-30, 31-60, 61-90, 91-120, 121-150, and 151-180, in order to adjust the forecast combat losses to the rates specified in the OSD Consolidated Guidance. Last, the computation is repeated for every month during which the war is forecast to endure, using guidance from the OSD Planning and Programing Guidance Memorandum as perpetuated in Plans and Policy Guidance. The wartime loss factors are developed by Concepts Analysis Agency and entered into the files of the SSN system. Concepts Analysis Agency, an element of the Army Staff, is under the operational control of the Deputy Chief of Staff for Research, Development, and Acquisition.

(2) *Mobilization training losses.* This is the quantity of equipment forecast to be worn out after the onset of war by Army units as they undergo intensive training prior to deployment. The IIQ required for wartime, multiplied by the peacetime replacement factor, provides the requirements. This computation is made only for units which will un-

dergo mobilization training and only for the period of time during which the training will last. The mobilization training losses are then added to the combat consumption in order to determine total Post D-day consumption. The peacetime replacement factor is determined by the major item managers in the materiel readiness commands and entered into the files of the SSN system. Note, however, that mobilization training losses are a part of the requirements. Major items are also bought to offset peacetime losses. Should war come, items purchased both for requirements and for normal peacetime losses would be available for the increased training losses.

4-11. Gross Requirements Computation Process

The Research, Development, and Acquisition Information Systems Agency (RDAISA), an organization under the operational control of the Deputy Chief of Staff for Research, Development, and Acquisition, has been assigned responsibility for computing gross requirements for Army-used major items. The sum of the required IIQ, the ORF, the RCF, additive OP's, special contingencies, and Post D-day consumption equals the total gross requirements. To make these computations, three things are needed:

a. Forces and equipment needs. These are the IIQ's which are the output product of the SACS processing, and are furnished to the Research, Development, and Acquisition Information Systems Agency by DCSOPS. It indicates, by LIN and by unit identification code, the quantities required and the quantities authorized, as well as other data related to the forces.

b. Guidance. This is furnished by DCSRDA's Plans and Policy Guidance, which provides instructions for relating Army units to the proper force strata, etc. It also furnishes the instructions to use in computation of Post D-day consumption, so that the computations will be in consonance with OSD's Consolidated Guidance.

c. A data base. The HQ, Depot System Command (DESCOM) is the proponent for the SSN system and its files which provide the latest factors for use in the gross requirements computation. The Logistics Systems Support Activity furnishes data on OP's.

4-12. The Army Acquisition Objective

After the gross requirements computations are completed by Research, Development, and Acquisition Information Systems Agency, the figures are forwarded to the materiel readiness commands and other agencies which prepare Army Materiel Plans. Simultaneously, acquisition personnel at MRC's determine the quantities of major items that can be obtained from industry during the period of time—

D-day to full wartime production. The gross requirements are reduced by the amount of this offset so that the Army does not procure during peacetime any quantity of equipment whose purchase could be delayed until after the onset of war. Therefore, gross requirements less the production offset equals the AAO, which is that quantity authorized for peacetime acquisition.

4-13. The Army Materiel Plan (AMP)

a. The materiel readiness commands receive the gross requirements computations from the Research, Development, and Acquisition Information Systems Agency and, using a computer program called SAMPAM, for "System for Automating Materiel Plans for Army Materiel," complete the AMP. The concept of SAMPAM is that all data necessary for AMP preparation, except gross requirements, is maintained in a current status in the computer data files—asset positions, age of assets, dues-in, future acquisition, levels of research and development, production offsets, production base support, etc. Upon receipt of the gross requirements magnetic tape, it is put online in the SAMPAM program and a completed AMP is produced within a very short time.

b. The AMP displays for the budget year and subsequent 5 years all the data necessary to make acquisition decisions concerning a major item, thereby, providing supporting details to justify the request for Procurement Appropriations.

c. The managing commands forward the completed AMP sheets to DA for review and a magnetic tape of the AMP to the Research, Development, and Acquisition Information Systems Agency for summarization into a Research, Development, and Acquisition Committee (RDAC) worksheets.

d. Here the budget year data is extracted from the AMP for use in the worksheets. Additionally, similar AMP sheets are summarized for the display. For example, if missile system ground support equipment consists of a launcher and three ancillary major items, the RDAC worksheet will show only the quantities of the launcher, it being the most important item. However, the costs for all four major items will be consolidated in the launcher display pages. Costs for the current year and the past year are also displayed.

e. When the RDAC worksheets are received by DA, they are further summarized into a P-1 Budget Display, which consists of those lines which the Army wants included in the Presidential budget. P-1 lines are very broad categories such as "ground support equipment for surface-to-surface missiles." The P-1 and the RDAC worksheets go through OSD and the Office of Management and Budget to the Office of the President. The AMP is NOT forwarded, but remains available for references as the appropriation process continues.

f. After sufficient time for study of budget requests, the Congress makes the defense appropriations; but, during this time frame, requirements are subject to both quantitative and qualitative change. Consequently, the AMP process repeats itself in 6 months, except that the final documentation goes to the Office of Management and Budget to assist in apportioning the appropriations. The Office of Management and Budget sends the funds down through Comptroller channels at the proper time. These are then used by the materiel readiness commands to finance new acquisition of major items. After delivery to Army control, these new items are distributed to claimants on a "free-issue" basis.

Section V. DISTRIBUTION REQUIREMENTS AND DISTRIBUTION PLANNING

4-14. Introduction

Distribution requirements are the allowance needed by approved force to accomplish each unit's peacetime mission. The Army goal is to obtain the best defensive posture with equipment on hand or due in within a short period. Distribution requirements are different from mobilization needs or wartime needs in that they apply to forces which are presently in being or which are planned for activation during peacetime. The calculation of distribution requirements is made for a given force without regard to the asset position. The availability of assets is then determined and distribution plans prepared.

4-15. Elements of Distribution Requirements

a. *The initial issue quantity.* This is the allowance authorized for current US Army units for units

planned for activation or reorganization during the period of distribution planning. These allowances are extracted from the SACS File described in paragraph 4-8a.

b. *Operational readiness float.* Major Army commands are authorized to stock ORF based on Department of the Army-approved ORF factors, times the density of equipment in the authorization documents of the units they support. ORF for overseas units is computed using the required quantities found in the authorization documents of the units being supported, excluding prepositioned overseas materiel configured into unit sets. ORF for units in the Continental United States is computed using the authorized quantities found in the authorization documents. The Reserve components are not authorized ORF support until mobilized except for aircraft and aircraft-related items. ORF for aircraft and

aircraft-related items is computed using the required quantities found in the authorization documents for both active and Reserve components of the total Army Force.

c. Repair cycle float. RCF is an additional quantity of mission-essential, maintenance-significant items of equipment specified by the materiel readiness commands for stockage at depot level. The RCF is based on the density of equipment authorized in the documents of units being supported and is put into use as replacement for equipment awaiting depot overhaul, in the depot overhaul process, or in transit to and from depot overhaul. RCF is computed on many items; however, asset stockage is based on HQDA approved maintenance policy.

d. War reserves (P/CD). These are stocks of materiel amassed in peacetime to meet increased materiel requirements upon an outbreak of war. We reserves provide the interim support essential to sustain operations until normal resupply can be effected. Types of war reserves include:

(1) *Decrementated stocks reserve.* That quantity of equipment necessary to bring the forward deployed Army units from their current authorized level of organization (ALO) to full strength.

(2) *Theater war reserves (TWR) (P/CS).* Stocks of mission-essential items (expressed in days of supply) authorized each theater to support Post D-day combat consumption until resupply from CONUS can be accomplished. These stocks are required to be pre-positioned in the appropriate theater.

(3) *Operational project stocks (P/CC).* These are authorizations which have been approved by HQDA, for major Army commands to acquire materiel for CONUS or theater stockage to support specific operations, contingencies, or war plans. These types of war reserves include additive and nonadditive operational project stocks, as defined below:

(a) *Pre-positioned materiel configured into unit sets (POMCUS) projects (P/CT).* Materiel to re-equip specific units with the equipment listed in their authorization documents upon deployment to the theater in which the materiel is stored.

(b) *Non-POMCUS projects (P/CT).* Requirements in addition to the equipment listed in unit's authorization documents, and in addition to the Post D-day combat consumption levels authorized, non-POMCUS operational projects are authorized for storage in both CONUS and in oversea areas.

(c) *Additive/nonadditive projects (P/CB).* Both POMCUS and non-POMCUS operational projects are further categorized as "additive" or "nonadditive" to the AAO.

1 Additive projects. Upon approval by DA, these projects automatically increase the AAO

by the quantities specified in the project. For example, some portions of POMCUS are additive.

2 Nonadditive projects. Although these projects require approval by DA, they do not increase the AAO. For example, most of the POMCUS projects are included in this category. Certain non-POMCUS projects may also be designated as nonadditive projects based on special considerations. These authorizations, although not increasing the AAO, do represent a claim on the equipment available to fulfill the overall distribution requirements.

(4) *CONUS war reserves (CONUS PPWL & GM).* This is that portion of the total mobilization war reserves which are held in CONUS depots under the control of the materiel readiness commands, the US Army Forces Command, or the US Army Training and Doctrine Command. They include:

(a) *Obligated war reserves (CONUS PPWR).* This portion of the total war reserves is located in the CONUS and is held for a specific force or area. Included in obligated war reserves are:

1 Contingency support stocks. These are war reserve stocks held for support of Post D-day combat consumption needs of the approved forces based in CONUS, but which may be deployed worldwide in case certain contingency plans are implemented.

2 Residual theater war reserves. That portion of the Post D-day combat consumption quantities authorized to support deployed forces. These stocks consist of equipment not authorized for pre-positioning in an oversea theater and equipment remaining in CONUS until after deployment of units designated to receive POMCUS stocks.

3 Special contingency stocks. These are war reserve stocks designated for support of the contingencies of allies.

(b) *Early mission Reserve component mobilization reserves.* These are the stocks necessary for issue to support the mobilization and deployment of the Reserve component units which have been scheduled for early deployment. Issue will bring the equipment level of these units and any needed operational readiness float to that level required to carry out their mission continuously in a wartime environment. These stocks should be on hand in the CONUS depot system.

(c) *Full Army mobilization reserves.* These stocks must be on hand in the depot system of CONUS to support full mobilization of all remaining Reserve component units as identified in the current SACS data. These reserves are sufficient to bring all remaining Reserve component forces from their current equipment level to that required for wartime, and to supply any needed ORF quantities as well.

(d) *General mobilization reserves.* That quantity of equipment necessary to bring active strength for general mobilization.

(4) *Computation of war reserve quantities.* These are computed in accordance with the levels specified by Army Regulation 11-11, the planned unit deployment schedules, the requirements set forth in the applicable contingency or mobilization plans, and the special policy and guidance furnished by the Deputy Chief of Staff for Operations and Plans.

(5) *Restrictions on peacetime use of war reserves.* Major items of equipment in theater war reserves, CONUS war reserves, or operational project stocks are not to be issued for peacetime use without the prior approval of HQDA.

4-16. Distribution Requirements Computation Process

The DESCOM has been assigned responsibility for the computation of distribution requirements and the development of distribution plans. The Deputy Chief of Staff for Operations and Plans furnishes SACS data indicating forces, required quantities, and authorized quantities. Guidance is furnished by the Deputy Chief of Staff for Logistics. The SSN system and its files are maintained by the DESCOM and are available for computations. Other sources of data used by DESCOM during the process include

operational project authorizations furnished by the Logistics System Support Activity, and exception type information furnished by the managing materiel readiness commands.

4-17. Distribution Planning

Using highly specialized computer programs, DESCOM matches programmed production of major items, which is obtained from the SAMPAM data base at the materiel readiness commands, to unfulfilled distribution requirements, thereby developing the distribution program (DAMPL). The priorities used may be those of the DA Master Priority List (DAMPL) (for the near term) and the DA Planned Priority List (DAPPL) (for future years), or as an exception to AR 11-12 the distribution priorities may relate to force packages. The distribution programs start at the current date and extend through the years covered in the latest Program Objective Memorandum. They are useful in advising the field commanders and higher headquarters of planned future distribution of the major items. However, the distribution programs are also used to display the impact of inadequate funds in the programming and budgeting process, and to study the feasibility of alternative force structures.

Section VI. THE ASSETS POSITION

4-18. Continuing Balance System

The accountable records of almost all wholesale and retail supply organizations in the US Army are maintained with data processing equipment and standardized computer programs. Programs have been designed and incorporated so that data on major items is identified and transmitted to the DESCOM in a format acceptable to the data processing equipment in use there. This command maintains for each major item a history of receipts from production, shipments to major commands, receipts by customers, losses by customers, and returns of unserviceable or excess. This transaction tracking system is called the "continuing balance system," and it is currently being expanded to track asset transactions through the battalion and separate company level. Asset positions developed through this system are used in the AMP, in related budgetary documentation, and in distribution plans for major items.

4-19. Type Classification and Logistics Control Codes

Each major item which is to be supported with repair parts by the Army supply system is assigned a type classification code and a logistics control code.

The type classification code indicates the suitability of major item for issue, while the logistics control code indicates the support actions and other considerations accorded to a major item by the wholesale segment of the supply system. For example, reclassification of a major item from "standard" to "contingency" is an action which may impact heavily upon the budget for Procurement Appropriations, because "contingency" type items are unsuitable for application to requirements. Type classification is covered in Army Regulation 71-6.

4-20. Reportable Item Control Code (RICC)

The RICC is assigned to major items based upon the importance of obtaining reports for specified usage. RICC 1 items are so classified by HQDA, and are used in readiness reporting. RICC 2 is assigned by the managing command to items of such importance that data must be collected for preparation of a worldwide asset position. Only data from RICC 1 and RICC 2 item transactions are transmitted to DESCOM for incorporation into their continuing balance system. RICC 3 is assigned to major items which are authorized to Reserve components, but not authorized to the Active Army.

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CHAPTER 5

SECONDARY ITEM MANAGEMENT

Section I. GENERAL

5-1. Introduction

a. Although major items are precisely defined and specific criteria are established for their selection, the same is not true for secondary items. Secondary items are currently defined as "end items, replacement assemblies, parts, and consumables, other than principal items."

b. Many items in the secondary items category have an annual turnover of \$50,000 or more, and some selected items in this category are just as critical to military effectiveness and materiel readiness as are principal items. Secondary items account for the great majority of supply management effort with the Army national inventory control points (NICP's) controlling the stocks of these items under AR 710-1.

5-2. Aspects of Secondary Item Management

a. There are three principal aspects of management of secondary items which vary according to the significance of the item.

(1) The management system requires extensive item-by-item reporting of present assets and past demand history in order to make projections of future requirements.

(2) Additional data are required to support detailed requirements computation of high management intensity items. These include item applications, projections of an end item populations (for repair parts), rebuild programs, dues out included

in program and demand forecasts, and other factors which may affect future demand. For items where such data are available, extensive supply control computations are performed manually or by computer, including calculation of "program factors" which may affect future demand, repair schedules, and the worldwide system of "pipeline" requirements. For other items, less information is made available and the computations are greatly simplified.

(3) Finally, the principle of selective and economic management dictates the frequent procurement of very high and high management intensity items. This is accomplished by balancing the administrative cost of review and procurement in relationship to the total inventory investment.

b. The measures taken in establishing the Army's inventory management system apply mainly to the determination of economic inventory levels and procurement frequencies, and to the regulation of workload in data reporting and computation. The Army recognizes that the principle of selective management must be measured against supply effectiveness. Cost is an important factor, but it is subsidiary to keeping troop units in maximum readiness to perform their assigned missions. The contribution of selective inventory control of supply effectiveness must, therefore, involve the prediction of demand patterns and the establishment of commensurate safety stocks in the supply system to provide effective supply under variable demand conditions.

Section II. MANAGEMENT METHODS FOR SECONDARY ITEMS

5-3. Selective Management

a. One of the most widely used philosophies of good inventory management in use today is that of selective management (Figure 5-1). It is philosophy which provides concise control over items selected for close attention because of their high dollar value, and for elimination of all but the most necessary details in the management of low dollar or low volume ma-

teriel. It is a dynamic and positive way to improve the Army requirements management of secondary items. The cost of management has a direct relationship to the importance and the cost of the item. Selective management policy identifies all secondary items as repairables and consumable and then arranges them further into four categories by value of next year's expected demand for the application of varying degrees of management. These are—

SELECTIVE MANAGEMENT OF SECONDARY ITEMS

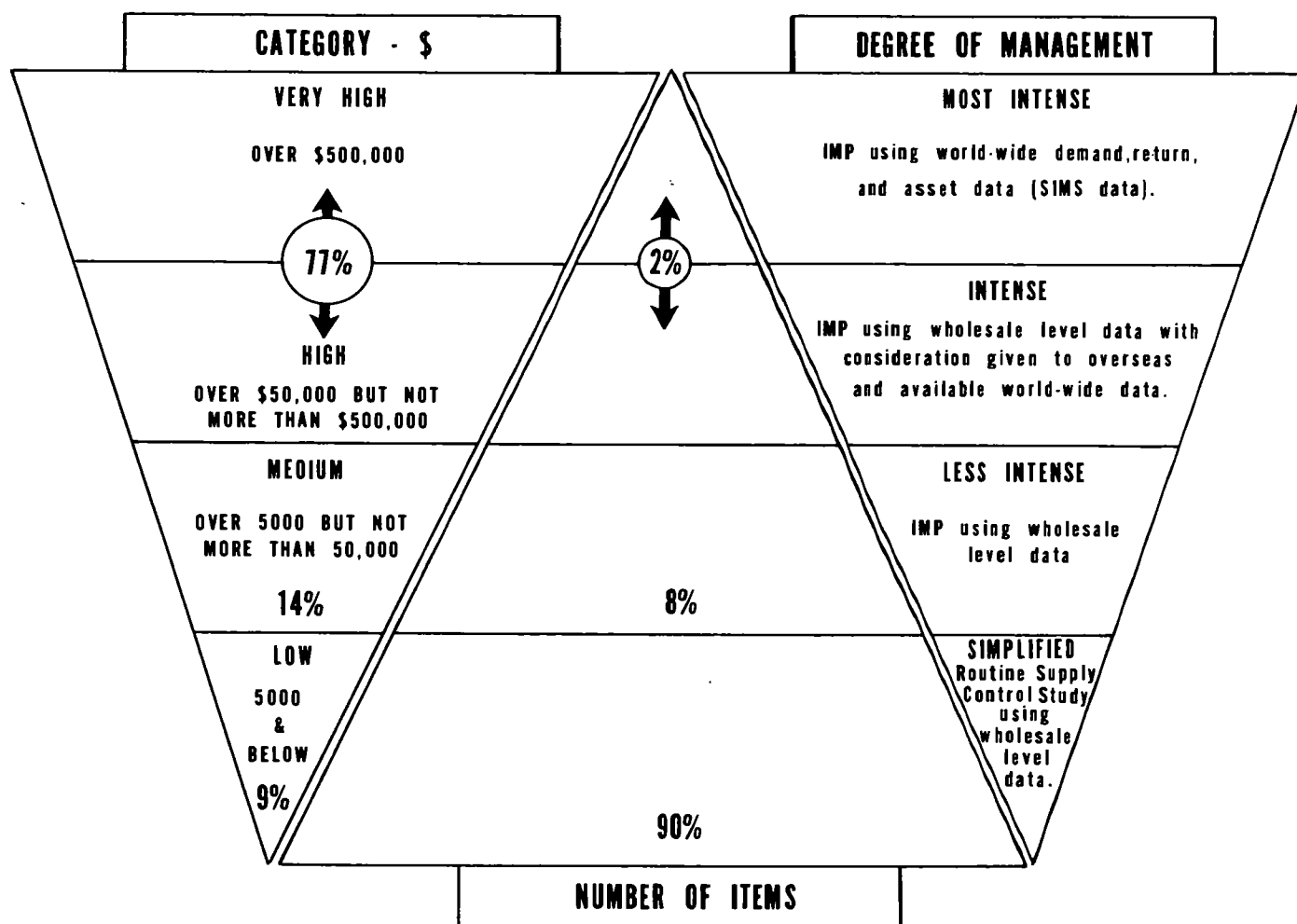


Figure 5-1. Selective management of secondary items.

(1) *Very high dollar value.* The dollar value of the gross annual demand for the item.

(2) *High dollar value.* The dollar value of the gross annual demand for the item is over \$50,000 but not more than \$500,000.

(3) *Medium dollar value.* The dollar value of the gross annual demand for the item is over \$5,000 but not more than \$50,000.

(4) *Low dollar value.* The dollar value of the gross annual demand for the item is \$5,000 or less or total procurements are under \$5,000.

b. Items will move from one dollar value grouping to another only when the annual demand or procurement value varies from the previous boundary value by 10 percent or more. However, once an item has become very high dollar value, it will remain in that grouping until the gross annual demand or procurement value falls to \$500,000 or below for two consecutive fiscal years.

c. The guidance furnished in AR 710-1 is based on this principle for selective management of secondary items. Items change category as demands fluctuate; however, to prevent overmanagement, the behavior of any given article should receive detailed analysis of all influencing factors to insure that the change is permanent before a shift is made.

d. The elements of selective management indicate a most intense degree of management for items of very high dollar value based on combat essentiality, cost, and criticality, an intense degree for materials of high dollar value and a lesser degree of management for the less costly items. Simplified management of the low dollar value material lends itself to almost complete mechanization.

5-4. Management by Exception

a. The principle of management by exception is applicable at all levels of supply but is ideally suited to the wholesale management of secondary items

because of the categorization of materiel from low to very high management intensity. The principle is exercised whenever an item, or items, creates a special problem which warrants management by exception. One technique is to shift a critical item into another category for closer management control. For example, a low management intensity item may be shifted to the medium or high management intensity category and thus automatically receive more frequent and more thorough analysis. In other cases, groups of items may be placed under control of an individual manager for closer management until such time as the items no longer need the higher degree of management intensity.

b. At the inventory control point level, computer control has been effectively utilized in both selective management and management by exception. All items are reviewed biweekly (may be monthly) by the computer to determine whether the item inventories have passed a reorder point or reached a maximum level (retention level). Item management plans are prepared by the computer when they reach their reorder point or there is an imbalance in the system. The computers are programed to reject those studies that exceed programed parameters, thus automatically bringing exception to the attention of the manager.

5-5. Automated Requirements Computations

a. The Requirements Determination and Execution System (RD/ES) is a fully automated system for secondary items that computes requirements, compares assets to requirements, determines immediate supply management actions, and simulates future supply actions for 5 years.

b. Two routines are used in RD/ES to compute requirements.

(1) An intensive supply management review routine produces an Item Management Plan (IMP); all very high, high, and medium management intensity items (all nonconsumable items) are processed through this routine. Items processed through this intensive routine use wholesale level data with consideration given to overseas and available worldwide data.

(2) The routine supply management review produces a supply control study for all low management intensity items (consumable items). This routine is similar to the intensive supply management review except computations are streamlined.

5-6. Selective Stockage

a. AR 710-1 establishes variable wholesale stockage criteria that is based on demand data (frequency and quantity), desired operational readiness goals for supported weapon systems/end items, and cost-effectiveness (cost to stock versus cost to not stock)

criteria. The overall objective of the wholesale stockage criteria is to identify those items that must be stocked to support readiness goals within funding and probable demand limitations.

b. AR 710-2 establishes retail stockage criteria based upon demand frequency or essentiality. This selective stockage plan results in the selection of secondary items for stockage which gives the greatest possible return in terms of filling the need of the echelon concerned. The plan applies the principle that a small portion of secondary items accounts for a large percentage of the requirement for secondary items at the user level. Figure 5-2 illustrates that from 15 to 20 percent of all secondary items account for approximately 85 percent of the demand by the user. By identifying items having the highest utility value, the plan insures that items most frequently used at forward echelons are stocked at, or as close to, that level as possible.

5-7. Special Management Systems

a. *Selected Item Management System—Expanded (SIMS-X).*

(1) *Background.*

(a) The generation of the SIMS-X concept has resulted from a series of factors. On 12 June 1968, DOD published DODI 4140.33, "Grouping of Secondary Items for Supply Management Purposes." This instruction established uniform DOD criteria for the grouping of secondary items to be accorded varying degrees of management control in the supply management process. On 7 August 1969, DOD published DODI 4140.37, "Asset Knowledge and Control of Secondary Items." The purpose of this instruction was to establish the authority and responsibility of the ICP's to extend asset knowledge and control over selected items to the supply and operating echelons beyond their current wholesale distribution activities. This knowledge was to be used by the ICP to determine materiel requirements, position assets, initiate repositioning actions, and control of excesses for the purpose of achieving maximum support within a given level of investment.

(b) The Army implementation of DODI 4140.37 was contained in TAG letter, 2 June 1970, "Selected Item Management System (SIMS)"; SIMS is a comprehensive system addressing requirements distribution, storage policies, and procedures for approximately 7,000 items through the DSU level. Visibility for major commands and NICP actions was provided by the Availability Balance File (ABF) and the Demand History File/Return History File (DHF/RHF) reporting systems. The lack of data credibility at the NICP and the retail level and supply policy system limitations which precluded central visibility of supply and system performance, resulted in a very limited implementation

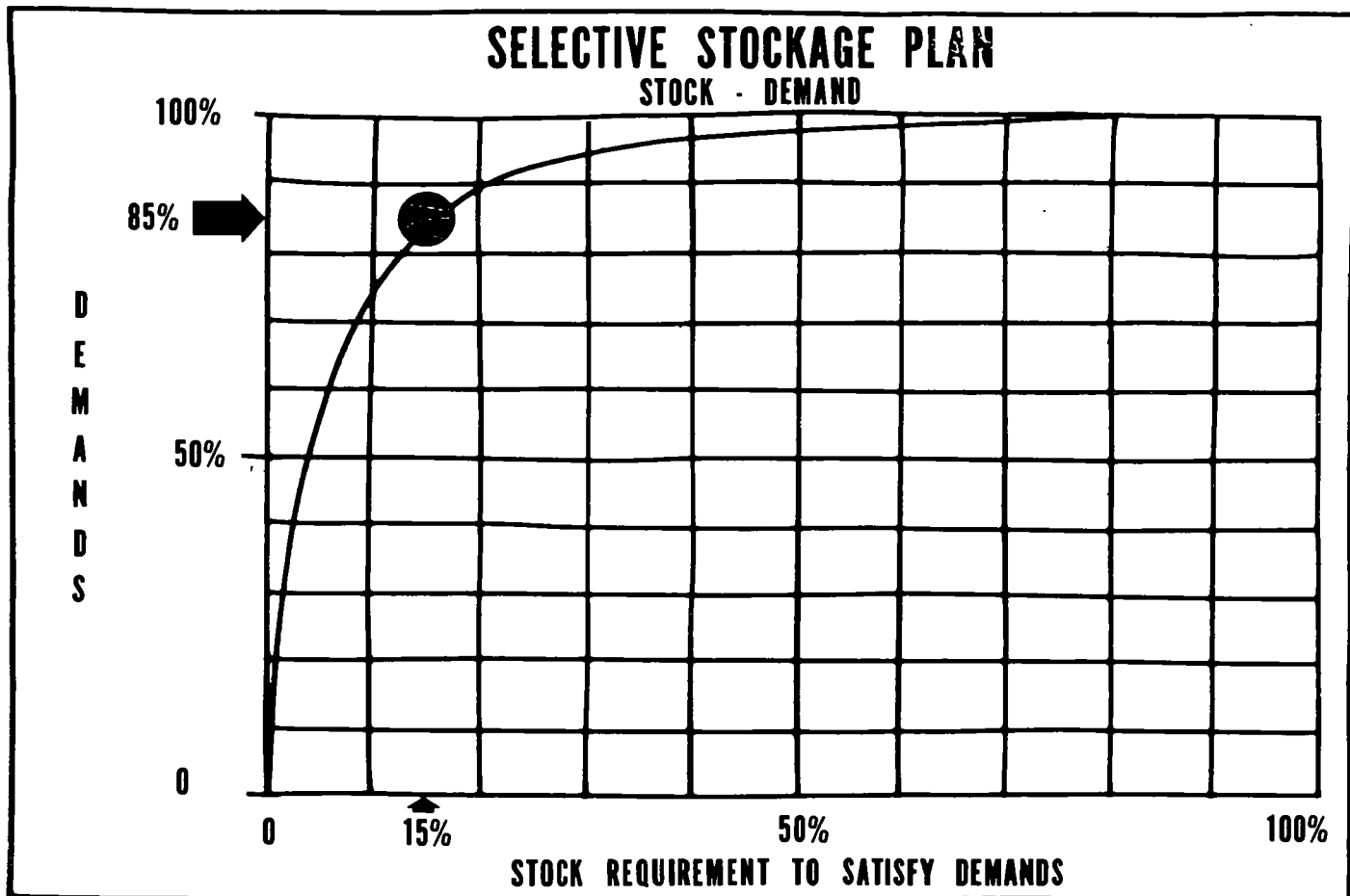


Figure 5-2. Selective stockage plan.

of SIMS. The selected secondary items covered under SIMS represented 90 percent of the Army's dollar value of annual demands for all secondary items. However, due to a multitude of command-unique information systems and the proliferation of non-standard data elements, the information available to the item manager was considerably out of date before any management usage of the data could be realized. The Army published in December 1970, Change 1 to AR 710.1, "Centralized Inventory Management of the Army Supply System." This regulation provides policy and procedural guidance for centralized inventory management of the Army Supply System.

(2) *General description of functional area.*

(a) SIMS-X is a concept of supply management which seeks to provide more prompt, cost effective field support through vertical visibility and control of supplies at multiple levels. The basic thrust is an extension of the DSS philosophy for minimizing pipeline and intermediate level staffing requirements. In SIMS-X, the concepts of variable intensity of management (i.e., "selected items" require more intensive management), and single DOD manager (Integrated Item Management) are applied. Hence, secondary items are grouped for supply management purposes (in accordance with DODI

4140.33) and MILSTANDARD codes and procedures are prescribed to enable interservice applicability of the concept (in accordance with DODI 4140.37, MILSTRAP and MILSTRIP). SIMS-X is intended to form the nucleus for a single, standard asset information and control system for all secondary and major items within the Army.

(b) In SIMS-X, Army (and other service) wholesale managers are required to:

1 Group secondary items for management purposes and report groupings in the AMDF (Army only).

2 Distribute report requirements, via DAAS and each service "Reporting Request Distribution Activity," to customer activities. Report specifications are coded and include variable report data, frequency, and type (status or transactions) for each item (NSN).

3 Maintain worldwide stock record account and intransit visibility through nonaccountable balance and/or transaction files based upon these reports. (This does not preclude a "central accountability" option within another service.)

4 Incorporate selected secondary requirements and asset data into supply control studies.

5 Redistribute retail stocks as necessary to meet worldwide requirements. (Policies to support this capability will be established based upon the wholesale stock position, transportation costs, issue priority designator, and projected leadtimes.) The N MCP is responsible for the filing of each requisition.

(c) Retail supply managers will:

1 Retain item and financial accountability.

2 Compute requisitioning objectives for and maintain limited stocks as prescribed by DA policy, and requisition replenishment requirements.

3 Issue stocks and supply status for assigned customers and upon MCP referral, and cross-level intratheater in accordance with DA policies.

4 Provide asset and/or transaction reports to the applicable MCP in accordance with specifications on the report request form for each item.

(d) Major command headquarters will be given responsibility and visibility for:

1 Monitoring the supply management performance by both subordinate and supporting (MCP) elements.

2 Influencing the distribution of critical items to and among subordinate elements.

(e) National level responsibilities and visibility requirements for SIMS-X include:

1 Performance measurement of worldwide inventory management of selected items.

2 Monitorship of visibility elements of the system.

(f) Materiel readiness is an essential element of force readiness and national security. Responsive materiel support is essential to the maintenance of the Army's overall readiness position. The materiel management system must respond to requirements in a manner commensurate with the designated urgency of need.

(g) Within the Army, secondary items amount to approximately 80 percent of all Army-managed items and about 47 percent of all items used by the Army. About 3 percent of the approximate 300,000 secondary items qualify for centralized control at the national/wholesale level under uniform criteria established by the Department of Defense. This small percentage of items accounts for more than 75 percent of the total annual Army secondary item budget expenditures. Given this disproportionate situation, systems support for the small percentage of items referred to cannot be determined by normal standards. The high value and criticality placed on these items requires a high level of management.

1 The guidance provided herein is intended to provide the basis for the development of detailed functional systems requirements (DFSR) for SIMS-X. It should be recognized that this document is in-

tended to provide the general functional description requiring further detail development.

2 The proposed system requires worldwide input of asset status and selected transaction data to the appropriate inventory control point (MCP) for consolidation and processing to provide increased visibility, accuracy, and verification capability of the data base which will yield:

a Improved operational readiness.

b Improved materiel distribution and repositioning.

c Improved worldwide supply management.

d Improved worldwide maintenance management.

e Reduced cost through reduced pipeline quantities, lower net stockage levels, and reduced procurement.

(h) The above benefits have the overall effect of an improved logistical support system which has the ultimate objective of improved support for the soldier in the field.

b. *Intransit Asset Visibility System.*

(1) The purpose of the Intransit Asset Visibility System is to provide MCP item managers with knowledge of selected Army materiel while that materiel is intransit and is not otherwise carried on the accountable records of any Army activity.

(2) The intransit system is designed as a computerized management information system which embraces the Army's logistic network from the wholesale level down to the lowest logistic support unit that maintains a stock record account, the direct support unit. The system utilizes the Logistics Intelligence File (LIF) and a data bank and calls for an intermediate level inventory control center (ICC) intransit data bank for each theater. These data banks will collect specific documents relating to the shipment of selected items of materiel from one Army account to another or direct vendor shipment to an Army account. A monthly status report of selected items intransit will be furnished by the data banks to each MCP.

5-8. Provisioning

a. Provisioning is defined in AR 310-25 and AR 700-18 as, "a management process for determining and acquiring the range and quantity of support items necessary to operate and maintain an end item of materiel for an initial period of service." DOD Directive 4140.40 provides further explanation by stating that, "Provisioning is a series of actions extending over a wide range of functions including design, maintenance planning, supply, requirements determination, item entry control, procurement, cataloging, and contract administration." The principal objective of provisioning is to insure the timely availability of minimum initial stocks of support items at using organizations and at maintenance

and supply activities to sustain the programed operation of end items until normal replenishment can be effected, and to provide this support at the least initial investment cost. The Integrated Logistics Support Plan, as developed in accordance with DOD Directive 4100.35, is the foundation upon which provisioning planning is developed.

b. There are three specific types of provisioning: Initial provisioning, the first time provisioning for a new end item; follow-on provisioning, a subsequent provisioning of the same end item from the same contractor; and reprovisioning, a subsequent provisioning of the same end item from a different contractor. From these types of provisioning, it can be seen that provisioning is not always a one-time occurrence. AR 700-120 lists the following situations that may occasion a form of provisioning. These are: equipment distribution to a command for the first time; increases of 25 percent or more in equipment density within a command; redistribution of equipment and related support items between commands; and product improvement of materiel located in a command. When these actions take place and provisioning is required, the range and quantity discussed in the basic definition can be described in terms of both hardware and software. This aggregation of wares includes: repair parts; special tools; test, measurement, and diagnostic equipment (TMDE), and maintenance literature, calibration standards equipment, and materiel required for onsite and offsite organization maintenance, direct support maintenance, and general support maintenance.

c. In its most formal sense, provisioning begins with the signing of the production contract for the end item. In reality, the forces that influence provisioning begin with a required operational capability and the development of reliability and maintainability requirements. The development of provisioning technical logistics data itself is principally accomplished during full-scale development in accordance with requirements imposed on the contractor by such programs as logistics support analysis (LSA) or maintenance engineering analysis (MEA). Additional data in the form of data elements may be obtained by a "Statement of Provisioning Requirements."

d. Generally, the first provisioning event after award of the production contract is the provisioning planning conference. The principal purpose of the provisioning planning conference is clarification of provisioning contractual requirements. Following the provisioning planning conference, a provisioning conference is held for the purpose of selecting repair parts, assigning or validating source, maintenance, and recoverability (SMR) codes, essentiality codes, maintenance factors, and other data of informa-

tion pertinent to determining initial support requirements.

e. A complete discussion of provisioning data elements and documentation is best left to TM 38-715-1 and Commodity Command Standard System Operating Instructions (CCSSOI). For the purposes of this manual, those principal data elements used in the requirements computation process will be examined. These are:

(1) *Maintenance factor*. A factor used to indicate the number of expected failures of the item expressed in failures per 100 end items for 1 year.

(2) *Source, maintenance, and recoverability codes*. Uniform SMR codes for use throughout the DOD and DLA are reflected in a joint regulation for which the Army Regulation number is 700-82. The following definitions apply to these codes:

(a) *Source code*. A two-position alpha code assigned to support items to indicate the manner of acquiring items for the maintenance, repair, or overhaul of end items.

(b) *Maintenance code*. A two-position alpha code assigned to support items to indicate the maintenance levels authorized to perform the required maintenance functions. The first digit, or Use Code, identifies the lowest maintenance level authorized to remove and replace the support item. The second digit, or Repair Code, identifies whether or not the item is repairable, and if so, the lowest maintenance level authorized complete repair responsibility.

(c) *Recoverability code*. A one-position code assigned to support items to indicate the disposition action of unserviceable support items.

(3) *Replacement rates*. Failures expressed in percentages which will result in the discard of a repairable item.

(4) *Order ship time*. The time elapsing between the initiating of stock replenishment action for a specific activity and the receipt of that activity of the material resulting from such action as expressed in days. Each level of supply is individually represented.

(5) *Turn around time*. The number of days from receipt of a failed item at a repair unit until the item is repaired and ready for reissue. Each level of repair is individually represented.

(6) *Density*. The total number of the item being provisioned that will be deployed worldwide. Density is considered as a total, a total for a particular geographic area, a total at the end of reorder point (ROP), and as a monthly average during ROP separate geographical areas.

(7) *Maintenance task distribution percentage*. Percentage of failures received at the various levels of maintenance (organization, direct support, and general support) within CONUS and overseas that

are repaired at these levels rather than being evacuated to the next higher level.

(8) *Requirements objective period.* The sum in months of the procurement leadtime and review cycle time. The ROP indicates the maximum quantity of stock to be on hand and on order to sustain current operations and objectives at any one time.

(9) *Initial issue indicator.* The number of days for initial issue quantity which is the quantity of an item required to provide support during the initial deployment of a weapon system or end item. This quantity is a nonrecurring demand.

f. In normal replenishment, demand data are recorded at various levels according to the importance of the item. In provisioning, this demand must be forecast. The requirements computation model used in provisioning is a development of the formula which states that quantity is the product of a rate and time, while recognizing that the quantity will vary directly with density. The term modeling is well chosen since the provisioning requirements computation process must model the wholesale and retail logistic structure. Essentially the computation process starts with the retail levels and computes requirements for initial issue, order and ship times, and turn around times requirements by maintenance category and by separate geographical area. Wholesale requirements are then computed and the sum of both retail and wholesale quantities minus available assets if any, are the net buy.

g. Because the basic indicator of failure is the maintenance factor, provisioning computations can have an immediacy that demand trends lack. To emphasize accuracy, the maintenance factor can be modified for environmental, wartime, and usage factors. Since the computation is basically a multiplication process, the law of direct proportionality ap-

plies to all data elements. For this reason validated and accurate engineering estimations are required throughout. Detailed guidance on provisioning requirements computation from both the viewpoint of policy and procedure is found in AR 700-18, TM 38-715-1, TM 38-715, and DODI 4140.42.

h. DODI 4140.42 was written to promulgate guidance in these areas. This instruction formally ties provisioning into DODI 4140.24 for developing program data for the purpose of budget or apportionment requests. In establishing Department of Defense policy for the determination of initial requirements for secondary item repair parts, the DODI has formally introduced several new techniques which are intended to both reduce provisioning risk and provide optimum repair part availability at lower costs. In the selection and stockage area, a technique is introduced to compare the costs of being back ordered versus the cost of stockage. When applied, this technique becomes a stockage criteria. Additionally DODI 4140.42 introduces a weighting technique for combining both the maintenance factor and actual demand data. Army implementation of this instruction is discussed in AR 700-18.

i. The requirements computation process is used to determine procurement quantities of the range of repair parts selected. The gaining command (user) is offered a quantity and range of support items to support operations in accordance with the number of end items that will be received in accordance with the Major Item Distribution Plan. It is this gaining command's responsibility to decide the range and quantity of support items required. This decision is based upon a review of the Master Support List prepared by the issuing activity. The distribution of support items is covered in AR 700-120 and AR 710-2.

Section III. SUPPLY MANAGEMENT TECHNIQUES

5-9. Introduction

a. This chapter is intended to give those engaged in the practice of supply management an appreciation of the concepts underlying modern inventory control and an overview of some of the quantitative techniques that are being more and more applied in supply management in the Department of Defense and industry. The intent is to provide an appreciation of the topics covered. Thus, the reader with an interest in learning techniques will have to supplement his reading for that purpose. Standard texts in inventory theory, probability, and related topics are cited in the appropriate chapters. Mathematics has been avoided wherever possible but some does appear essential to the material being presented.

b. In selecting materiel to be presented, an attempt has been made to emphasize concepts and methodol-

ogy currently in use in the Department of the Army or expected to come into use in the foreseeable future. This will lead to lighter treatment of some topics that, perhaps, are quite commonly given emphasis in texts slanted towards industrial applications. Where this is done, those features or characteristics of the military supply system that restrict their applicability will be discussed. Further, terminology familiar to Army personnel will be used throughout. But, terms that are perhaps new to some will appear, particularly in the discussions of probabilistic systems; these are extremely important and it is hoped that this materiel will help bring them into the vocabulary of Army supply managers.

c. The principles described in this section apply to all levels of the Army supply system. Differences in terminology at the wholesale and retail levels some-

times tend to obscure the fact that the principles and often even the methodology are the same; thus, care will be taken to define terms for universal application. Finally, most of the materiel will be slanted towards the supply management of repair parts. The concepts described will for the most part be applicable to other classes of supply, but it is in the management of repair parts that some of the most formidable complexities arise, and it is in the management of these items that the more advanced concepts find major application.

5-10. Behavior of an Inventory System

a. In referring to the Army's supply system, it is common practice to speak of a wholesale system, comprising the national inventory control points and depots of the US DARCOM, and a retail system, which is viewed as its customers. In reality, of course, many of these customers are themselves wholesalers in that they lay in supplies in anticipation of demands from their customers. The system is thus frequently represented as a "tree" with the wholesale system indicated as a node at the top supporting a set of nodes one level down each of which supports its set of nodes one level further down and so on until the bottom level is reached, where the ultimate user of the material is located.

b. This, however, is perhaps too simple a view of the Army supply system. First, many of these so-called retail organizations such as the overseas theaters and some of the large CONUS activities perform supply functions that are exactly analogous to those performed by the DARCON activities and are themselves so large that it may be misleading to conceive of them as retail establishments. Second, among organizations at all levels in the system are frequently both suppliers and consumers. At the DARCOM level, for example, the depots issue supplies to customers but, at the same time, operate rebuild shops which are themselves large consumers of parts. Similarly, the direct support units in the retail system serve as supply points to maneuver battalions but at the same time carry out repair functions that cause parts and other supplies to be consumed. Even within maneuver battalions, one sees both supply and repair activities and associated organizational entities that supply and consume, respectively.

c. On the other hand, there are large customers of the DARCOM that are known to function like wholesalers to lower level supply and maintenance organizations but which, for all practical purposes, appear to DARCOM as if they are only consumers. Mutual Security Pact countries are like this; they manage their own logistics systems and everything issued to them by the Army is, for all intents and purposes, immediately consumed. Thus, conceptually, they behave in the very same way as any other

organization that is represented as a terminal node in the system "tree." What happens beneath that node is generally not known to the Army and thus, stocks issued to this class of customer must normally be considered as consumed once they leave the Army system.

d. This leads to the consideration of the types of items of supply. In the Army, these are divided into two general types: consumables and reparable. The distinction seems quite natural. Food, once issued to a consumer, is eaten; gasoline, once issued to a consumer, is burned away. An aircraft engine, on the other hand, once issued to an aviation company and installed on a plane, is not consumed unless, of course, it is lost in combat or so badly damaged that it cannot be returned to useful service; when it fails, it can be repaired and used time after time.

e. The rates at which consumable items are consumed and reparable items fail can be considered as the events that trigger the supply system. The infantryman asks for a new pair of combat boots when his old ones wear out. The Electronic technician asks for a new diode to replace one that has failed or for a new amplifier assembly when the installed one has to be removed for repair. These requests from the consumer to the appropriate supplier cause an item to be issued if it is in stock or causes the supplier to ask his supplier for the item if he doesn't have it.

f. Yet, it is not these requests that drive the supply system. The driving force is really the anticipation of these events, for it is the function of the supplier at every level in the supply system to foretell when these events will happen, where they will happen, and how often they will happen. And it is these forecasts of what the supply manager expects to happen in the future that cause him to set up requirements objectives, reorder points, reorder cycles, etc., and to initiate supply actions to have the items available for the consumer before the consumption or failure events actually take place. This is the heart of the item manager's function, his major responsibility, and the single most important activity he performs.

5-11. The Failure Process

a. Many items used by the Army are consumed on a regular basis or are issued to meet programs that are well known in advance. As a consequence, their requirements can be forecasted rather well. This is not the case, however, on the overwhelming majority of items. The consumption rates of consumable repair parts and the failure rates of reparable components, assemblies, and equipments are particularly troublesome and it is to these items that most attention will be directed.

b. It has been the practice in some circles to consider items that fail as belonging to one of two general classes, those that wear out and those that are

subject to random failure. In truth, however, all items that fail do so because they wear out and the wear-out process is in all cases a random one. Consider an automobile tire. It definitely wears out with use. However, the exact number of miles a particular tire can go before requiring replacement is a random variable. Take a group of tires from the same manufacturing lot rated to last for 25,000 miles. Some will need to be replaced at 24,000 miles, some at 26,000; some may even blow out at lower mileage or sustain fatal road damage in their very first miles of use. But, in any event, one would expect most of them to last for somewhere around 25,000 miles, given equivalent operating environment. Their mean-time-to-failure could be expressed in terms of this expected tire life and expected replacement requirements could be determined using this rated life and expected vehicle usage. For example, if we equip a fleet of 100 trucks with new tires (four tires per truck) on a particular date and

Expected tire life = 25,000 miles
 Expected usage per truck = 12,500 miles per year

we would expect to need 400 new tires in about 2 years. But, this doesn't mean that we won't need some tires during the first year. Some trucks may experience blowouts or some may travel 30,000 miles in the first year while some travel hardly at all. So there should be no surprise if some requirements pop up at random due either to random fluctuations in the quality of the tires or random fluctuations in the conditions of operation.

c. A similar situation exists with, for example, aircraft engines. Here it is customary for a requirement to exist requiring all engines to be removed for mandatory overhaul after they have logged, say, 1,000 hours of operation. Because of this, one might think that a regular pattern of removals for overhaul would be experienced. Quite the contrary is true. First, many engines experience failures and require overhaul before their mandatory time between overhaul (MTBO) is reached. Also, the number of hours flown by individual aircraft turns out to be quite variable. As a result, the removal patterns of aircraft engines generally turn out to look very much like random processes.

d. Another condition is frequently experienced that causes the demand patterns of items normally thought of as wear-out items to look just like a random process. Take the case of fuel pumps installed in a fleet of trucks that have a rated life of 10,000 miles. When the trucks are first put into service, all fuel pumps are new and only early failure should be experienced, with the number of failures increasing as the number of trucks approaching 10,000 miles of use increases. But, each fuel pump that fails will be replaced by a new one, so that after a period of time,

the ages of the installed fuel pumps will not all be the same. As a matter of fact, after a period of time (which, incidentally, turns out to be a lot shorter than intuition would lead one to expect), the age distribution of the installed pumps will be so mixed up that, even though most of them are failing at about 10,000 miles of usage, the failure process in calendar time of the pump population will also look very much like a random process.

e. Still another situation that is encountered is this: one frequently hears of the "bathtub curve" as representing the failure pattern that one should expect to see over an item's life cycle. Failures can be expected to be frequent during the item's early life, settling down to a relatively low but essentially constant level with random fluctuations during the middle year of life, and finally increasing rapidly towards the end of the item's life as it begins to approach its wear-out period. One frequently sees this conceptual process diagramed in this way:

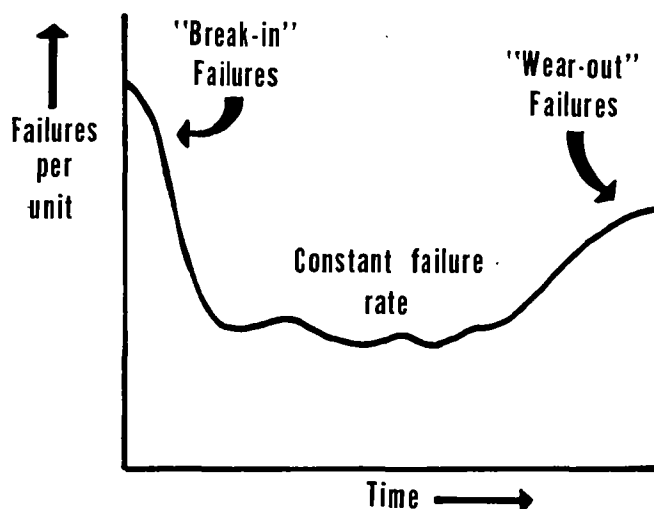


Figure 5-8. Conceptual process.

Now, this may in fact be what the failure rate of an individual piece of equipment looks like over its life cycle. Your own automobile may, in fact, show this pattern if you keep it long enough. But, few weapon system populations or fleets of military vehicles will be found on which this pattern shows up clearly; first, because entire populations are seldom deployed all at once; second, because of the mixture of component ages due to replacement; and, third, because of overhaul and rebuild programs. So the "bathtub curve" as a predictive device is not of much practical use.

f. Finally, what about electronic items? These are frequently cited as items that experience only random failures. In one sense, this is true but, actually, they fail because they wear out just as mechanical items do. The major difference is that electronic components generally have very long expected lives, so long, in fact, that many of them never approach the ends

of their expected lives during the entire time they are in service. All that one ever experiences on these items are the random failures that one sees during the early days of a tire's life or a fuel pump's life.

g. All this discussion was given for one purpose; that is, to declare that the failure or consumption process on most military items will be found to be a random process, whether the item is thought of as a random failure item or a wear-out item. This does not mean that the expected failures in a particular time period cannot be forecasted. They can—and so can the expected variability. But it must be expected that these forecasts of failures or consumption rates will be subject to error, probably quite large error. How to make use of knowledge of the item's characteristics, its expected use, environment, and other factors to reduce the prediction error and to protect the system from consequences of prediction error will be a major concern of subsequent chapters.

5-12. Types of Demand

a. As said before, while the need for an item by a consumer serves as the initial trigger to activate the supply system, it is the anticipation of this need by the suppliers that drives the system. For it is this anticipation of need that causes suppliers, from the lowest level in the system to the highest, to set requirements levels and to place requisitions on their supporting suppliers to insure the presence of stocks when their customers come to them. The higher one goes in the supply system, the less these requisitions tend to represent actual consumption. Unless they happen to be requisitions from an actual consumer that have been passed up the line because of the items not being available, the requisitions most frequently seen by suppliers that are at least one level away from the consumer are requisitions submitted to stock the bins of a lower level supplier who is anticipating some need on the part of his customers.

b. These requisitions placed on suppliers are commonly referred to as demands. In addition to their function as supply action triggers, they also constitute the data source that is most commonly used in military supply systems for the prediction of customers' future needs. For suppliers who are directly servicing consumers, the demands are used as a basis for anticipating future consumption. For higher level suppliers, they are used as a basis for predicting what their customers are anticipating their needs to be. What causes these demands to arise is an important consideration since knowledge of the cause of demand previously experienced is frequently an aid in predicting future need. Basically two types of demand are defined—recurring and nonrecurring. The former is defined to be demand that can be expected to occur again and again in the future; the latter is defined as demand that is of a one-time

nature, not expected to be experienced again in the future, or demand that is directly associated with a particular program which is presumably not expected to occur again in the future in exactly the same way. Note that either type of demand may be either for direct consumption or for stocking the bins of another supplier who anticipates demands from his customers.

c. From the standpoint of an item manager, the importance of these demand classifications is to enable him to identify those demands that are associated with particular events or programs that are not expected to occur again in the future. Demands for oscilloscopes, meters, etc., needed to outfit a newly activated maintenance battalion, for example, have to be identified as such, for the item manager obviously doesn't want to reorder these items unless he knows that another battalion of the same type is to be activated. Similarly, parts needed to support a rebuild program for a particular armored personnel carrier (APC) would not have to be ordered again unless the item manager is informed that another rebuild program for the same APC is being planned. Presumably, then, all demands of this type are identified by the requisitioner as nonrecurring and are deleted from the body of demand data that will be used in the projection of future anticipated demand. All other types of demand are identified by the requisitioner as recurring, implying that the need is considered to be of a repetitive type and expected to arise again and again in the future. Spark plugs, for example, can be expected to be needed so long as the vehicles in which they are installed keep travelling. This does not mean, of course, that recurring demand is not program related. It frequently is. It is not unreasonable, for example, to expect that the anticipation of need for spark plugs is related to the number of vehicles in the field and the number of miles they are expected to travel. The main point is that it is expected to occur again and again in the future exactly as it occurred in the past, except as modified by extraneous factors such as changes in level of field activity, aging of equipment, etc.

d. The requirement in AR 725-50 that the requisitioner specify in his requisition whether his demand is a recurring or nonrecurring one raises a troublesome problem. It is quite possible that the requisitioner from his vantage point sees a demand as a nonrecurring one, and quite properly so, when in fact, a collection of nonrecurring demands from a number of customers arriving at a higher level supplier may appear to be of a recurring nature. An assembly cracked in a landing accident may seem like an event not likely to occur again in the future to a mechanic on the flight line and he may, therefore, be completely justified in coding his requisition as nonrecurring. To an item manager at an NICP, however,

who may be receiving similarly coded requisitions for the same part from all over the world, and who has seen these same requisitions come in year after year, the need seems very much like a recurring one and he would be completely justified in treating these as recurring requisitions and in anticipating continuing future need for the part. Thus, the 6655 system allows a system manager at the NICP level to change a fraction of the nonrecurring requisitions to recurring in cases where his experience indicates to him that this sort of thing is happening. The fraction he changes is dictated by his experience.

5-13. Risk and Uncertainty

a. One will find in some texts on decision theory a distinction made between decisions made in the face of risk and decisions made under uncertainty. In this contest, risk is associated with the situation where the possible outcomes of the decision and the probabilities that each will occur are known to the decision maker. Uncertainty refers to the situation where the decision maker may know the possible outcomes but not their probabilities of occurrence or where he doesn't know the possible outcomes at all. Recognition of this distinction in a formal sense is not too important in the supply management concept. For one thing, it is almost never possible really to know the probabilities that certain outcomes will occur. The best one can do is estimate them based on past experience and hope that the experience on which the estimate was based will be appropriate for application in the future. Nevertheless, there is some benefit in recognizing that in some situations the future is truly uncertain and that one may have to discard past experience in formulating a decision for the future. This is now illustrated.

b. Experience and past data are widely used to estimate the probabilities of what will happen in the future. This, in fact, is the subject of much of this chapter. Analysis of past demand and program data enables us to estimate that a given customer's demand will be so much over a given period of time in the future. Now, we know that this estimate is subject to error but this same analysis can tell us how to estimate the amount of forecast error to expect. Knowing this, we can say that if a particular safety level is provided we can expect so many backorders; increase the safety level by so much and the expected backorders will decrease by so much. With this knowledge, the decision maker is better equipped to face the question of how much money to allow for inventory investment. Attaching probability statements to future events presupposes, however, that what happened in the past is representative of what is going to happen in the future. Unfortunately, if the future turns out to be completely different in important ways from the past, the probability state-

ments inferred from past data may not be too useful. Thus, past demand history was not too useful in predicting customer demand in the early stages of the Vietnam war.

c. It is important to recognize that supply management policies (aside from those dealing specifically with mobilization reserves and contingency planning) are designed mainly to deal with situations of risk rather than uncertainty—that is, policies on how to project and provide for future need are based on the assumption that meaningful probability statements can be made about the future based upon observations of the past. So, one's projections about future deliveries of an item do not take into account the possibility that the plant might be wiped out in a fire or a flood. Nor do projections of requirements during the midst of a war take into account the possibility that the opponent might surrender next month. Events like these lie in the realm of uncertainty. The supply manager must react, and promptly, to such events when they do occur, but policies formulated at the supply management level are not designed to take them into account in advance.

5-14. Substitutability of Resources

a. When the future is not deterministic, one can usually mitigate the consequences of an unfavorable outcome by investment of additional resources. In a situation where the probabilities of the outcomes can be estimated, the degree of mitigation afforded by the investment of a given amount of resource can also be estimated. Thus, if it is known that the probability that the demand for an item during its replenishment lead time will be greater than a certain amount, the number of backorders to be experienced with a given inventory investment can be estimated; moreover, the reduction in expected backorders that will be achieved for each unit of increase in the inventory investment can be estimated.

b. If this can be done, why are backorders experienced at all? This is not an idle question. Frequently inventory managers are admonished to achieve "100 percent supply performance on this group of items" or "don't ever go out of stock on this group; they're too important!" Unfortunately, a principle everyone is familiar with, the "law of diminishing returns," is at work in most situations and this ideal cannot be achieved. What one usually finds is that, after a certain point is reached, each additional unit of resource added brings a smaller and smaller return. In our inventory context, a situation like this exists. One can come closer and closer to the 100 percent line—indeed, while we can't actually reach it, we can come as close as we want (99.9999 . . . if we wish) but every little bit of improvement requires more and more resource. And, as every inventory manager knows, resources are always limited, frequently

severely constrained, so there are definite limits to what one can achieve.

c. When one thinks of resources, it is usually money that is thought of. For our purposes, however, it is more useful to think not of money itself but of what money can buy. Thus, when we discuss resources and their application in a logistic system, we think of such things as inventory (the major items, assemblies, components, repair parts) maintenance facilities, transportation and the like. And, of course, people. Since all these things can be procured, within limits, by money, it is possible to think of them as being interchangeable or substitutable for one another, again within limits. And, indeed, this is the central concern of modern logistical planning—what type of resource, if added to the system, will bring the greatest return in terms of performance improvement, for each dollar spent? Or, put another way, if there is a fixed amount of dollars to be spent, on what resources should these dollars be spent in order to get the best possible system performance?

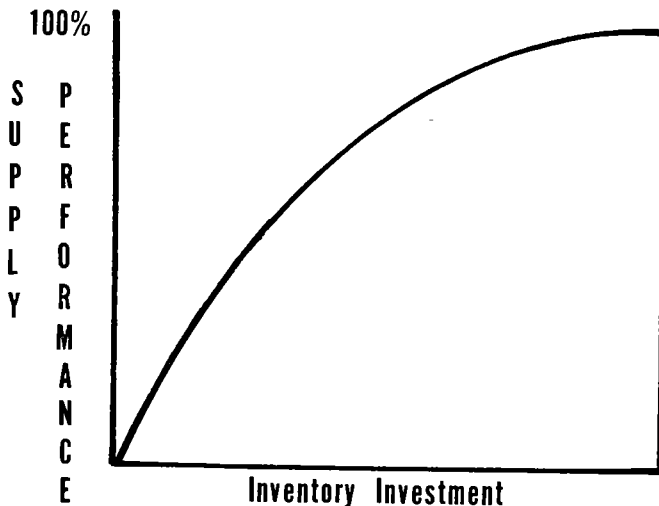


Figure 5-4. Supply performance.

d. The types of resources one usually thinks of as offering performance improvement potential for an inventory system are as follows:

(1) *Inventory*. This is obvious. What is perhaps not so obvious is that there are all kinds of trade-offs that can be considered within the inventory itself. For example, one can consider the relative worth of buying a few extra aircraft instead of a lot of spare engines or buying assemblies instead of repair parts. Questions of this kind are of great importance when a new system is being designed and when deployment schemes are being developed, for it is sometimes possible to achieve large dollar savings or better performance of both if the right mix is chosen.

(2) *Maintenance*. This is a corollary to inventory yet all too often the closeness of the interdependence of these two resources is given insufficient attention. Most directly, maintenance effort

can be applied to reduce the amount of inventory investment needed. Or, conversely, a shortage of the maintenance resource can make large increases in inventory necessary. For example, a shortage of skilled mechanics in an aircraft engine repair facility means more time required to get engines repaired; more repair time means that more engines are required to keep the same level of flying program going.

(3) *Transportation*. An obvious resource for the inventory manager. The faster the supplies can get the item to the point of need, the less inventory the system requires. The same applies to the return of unserviceables to the repair facility. Until recently, however, most Army logisticians have tended to think of premium transportation (e.g., airlift) as justified only for emergency needs. The notion of deliberately paying a premium charge to move a low priority shipment was thought of as heresy. Yet it can be shown that there are many items where this additional transportation cost can be more than offset by the reductions that can be made in the inventory investment, simply because the customer's resupply time is shorter.

(4) *Reliability*. This is a resource whose substitution for inventory is perhaps not so obvious. But this is frequently the avenue that may offer the most potential for inventory investment reduction. We think of it as a resource because improved reliability can be bought by investing in engineering effort, by manufacturing with better components, by providing redundant circuits, etc. Consider tank track, aircraft engines, for example. Think of the amount of inventory investment that can be saved for every 100 miles added to its expected life. Large savings in spare engine requirements and in maintenance and transportation costs, too, can be had by increasing the engine's mandatory-time-between-overhaul. All too often the solution to a poor supply performance situation is not to buy more inventory but to fix the design so the item doesn't fail as frequently.

(5) *Production*. The resources represented by production facilities are another type of resource that can be used to substitute for inventories. A good example is dry batteries. Extremely high variability in the demand for these items would ordinarily necessitate enormous safety levels to keep supply performance at desired levels. But it is possible by spending somewhat more money in the procurement process to induce manufacturers to agree to requirements-type contracts under which they guarantee to provide a flexible production base that enables them to respond to monthly delivery calls of varying amounts, all within agreed upon upper and lower limits, of course, but sufficiently broad that safety level reductions far in excess of the increased pro-

curement cost can be achieved. There are perhaps too many items on which this kind of trade-off can be made but, where it is possible, the savings can often be tremendous.

(6) *Management intensity.* This is a resource that includes a variety of aspects. The principle is well understood: if the items don't cost much, get good supply performance by investing in inventory; if they are costly, substitute intensity of management rather than tie up large sums of money in inventory. Increasing the intensity of management can be done in a number of ways, such as assigning more people or people with higher skills to the management of the more expensive items, increase the amount of information available to the manager (e.g., field reporting of assets and maintenance programs, more specific program data etc.), increase the opportunities for communication between supplier and user. Intensity of management is not reserved, of course, for expensive items. The importance of the item to the military mission is always of paramount concern and, for essential items, the application of more intensive management is often more desirable than inventory investment.

e. The ways in which these different types of resources are related one to the other are usually quite complicated. The decisions as to how much of one type ought to be substituted for another in order to lower costs or to achieve better performance without additional cost are quite difficult to make. Yet the principle is simple. It is illustrated in the following example:

(1) Suppose a particular type of aircraft engine is subject to field failures that take, on the average, 5 days to repair. Suppose also that these engines have to be removed periodically for overhaul which takes, on the average, 30 days. Now, assume that these engines are being removed at the rate of one a day and that, of these removals, 80 percent are field failures with the remaining 20 percent requiring overhaul. Suppose, now, that the repair and overhaul facility is a centralized one and that it takes 30 days to ship an unserviceable engine from the field to this facility and 30 days for the return shipment of serviceables back to the field. The number of engines required to be in the pipeline (safety level omitted to keep the example simple) is—

$$\begin{array}{r} (1 \text{ removal/day for field failures} \times .8) = 52 \\ (30 \text{ days} + 5 + 30) \\ + (1 \text{ removal/day for overhaul} \times .2) = 18 \\ (30 \text{ days} + 30 + 30) \\ \hline 70 \text{ engines} \end{array}$$

Therefore 70 engines will be required in the pipeline using surface transportation.

(2) A logistician interested in reducing the number of engines in the pipeline might decide to fly

these engines to and from the field. Suppose this would reduce the shipping time each way to 5 days. Then the total number of engines required would be—

$$\begin{array}{r} (1 \times .8)(5 + 5 + 5) = 12 \\ (1 \times .2)(5 + 30 + 5) = 8 \\ \hline 20 \text{ engines} \end{array}$$

Only 20 engines will be required in the pipeline using air transportation. If these engines cost \$25,000 each, a $50 \times \$25,000 = \$1,250,000$ reduction in inventory investment would thus be possible. If it costs \$200 more to ship an engine by air each way, the annual added shipping cost would be—

$$\begin{array}{r} 2 \text{ shipments a day (one to one from)} \times 365 \times \\ \$200 = \$146,000 \end{array}$$

Now, if these engines have not yet been bought, it obviously appears desirable to use air shipment because one can pay for many, many years of air shipment as can be seen, for the cost of 50 engines worth \$25,000 each.

(3) Suppose, however, another course of action were to be considered—namely to move the personnel, tools, and equipment needed for field repairs out of the central facility and into the field. If, by establishing the field repair facility close to the point of failure, it is possible to reduce the shipment time each way from 30 days to 5 days, the number of engines required to be in the pipeline would be (leaving overhaul as is)—

Overseas Repair

$$\begin{array}{r} (1 \times .8)(5 + 5 + 5) = 12 \\ \text{CONUS overhaul—surface transportation} \\ (1 \times .2)(30 + 30 + 30) = 18 \\ \hline 30 \text{ engines} \end{array}$$

The increase in investment between this support plan and the one involving air shipment to the central facility is—

$$(30 \text{ engines} - 20) \times \$25,000 = \$250,000$$

in favor of the air shipment plan. But, if it costs \$250 less per shipment to move engines to and from the field repair facility than it does to air ship them to and from the central facility, the transportation cost saving is—

$$\begin{array}{r} (1 \text{ removal a day} \times .8) \\ \times 2 \text{ shipments per re-} \\ \text{moval} \times \$250 \times 365 = \$146,000 \text{ a year} \end{array}$$

In addition the following savings are generated by eliminating air returns for overhaul of engines in CONUS.

$$\begin{array}{r} (1 \text{ removal a day} \times .2) \times 2 \times \$200 \times 365 = 29,200 \\ \hline \$175,200 \end{array}$$

Therefore the total savings would be—

$$\$146,000 + \$29,200 = \$175,200$$

Now the larger inventory investment reduction that is possible under air shipment doesn't look as advantageous because the difference would be offset by the higher transportation cost within 2 years. In all likelihood, the decentralized repair facility support plan would be chosen. This example, of course, is intended only as an illustration of the principle of the substitutability of resources—the ability one has within the logistics system to trade-off one type of resource for another and thereby attain cost savings or improve performance or both. In actuality, many

other factors would enter into the decision, such as the feasibility of separating the repair function from the overhaul function without incurring additional costs for personnel, tools, and test equipment, the cost of building a field repair facility, etc. Also the actual economic analysis is really more complicated than indicated in the example because of the need to take the present value of future expenditures into account. (This will be discussed later in the section on long and short range costs.) Nevertheless, the example suffices to illustrate the principle. The succeeding sections of this chapter will include discussions of techniques that can be applied to evaluate these trade-off possibilities in the inventory area.

Section IV. REQUIREMENTS DETERMINATION

5-15. The Requirements Forecast

a. The discussion in this section on the projection of future requirements is intended to be introductory since it is limited to requirements projection in a deterministic world—a world in which all forecasts turn out to be true. Later, in the sections on probabilistic inventory models and forecasting, we will see that the forecasts of a deterministic world are, for the most part, only expected values in a probabilistic world. But, for the moment, we will credit ourselves with omniscience. When we say that our demand rate is 100 per year, we expect to have exactly 100 demanded next year; when we say that the procurement leadtime is 9 months, we expect that a Procurement Work Directive issued on 1 July will result in a delivery next 1 April.

b. In general, the minimum information a requirements forecast must contain is the time period in which the demand is expected to occur and the quantity. Additionally, it is often necessary to know the expected customer's identity and location so that incoming stocks may be reserved for his use when authorized and so that the stocks may be geographically located so as to avoid uneconomical shipments. In the deterministic world, all these are assumed to be known. Often, however, it is necessary to express the expected future demand in distinctly different ways, even in the deterministic world. For example, the Commodity Command Standard System (CCSS) provides for expressing future requirements as a—

(1) *Rate*. This is the normal way in which recurring demand (see AR 710-1) is expressed. It can be expressed as an average monthly demand (AMD), average quarterly demand (AQD), or an average yearly demand (AYD). To get the expected demand over a future time period, this rate is merely multiplied by the appropriate time period. This rate need not remain constant over all future time, in fact, it is frequently modified by consideration of program data. More will be said about this later.

(2) *Rate with a start and stop date*. This can be used to express a special requirement such as a special troop exercise when it is expected that the items will be consumed or used at a given rate only while the exercise is in progress.

(3) *Schedule such as is used to express the requirements for parts to support depot overhaul or a set assembly program*. Here the nature of the program, both as to timing and quantity of end items to be rebuilt or sets to be assembled in each future time period are known, as are the expected parts usage per unit rebuilt or set assembled. The requirements schedule usually quarterly, is then obtained by a parts explosion, each quantitative requirement being placed in its proper time slot. Each quarter's requirement is then deleted as its time passes.

(4) *Draw-down quantity*. In this case, a requirement may exist for a particular quantity but the exact time when the demand will occur is not known. An example might be the expected initial issue of an item to a newly fielded organization. Here, the document identifier or a project code on the incoming requisitions can be used to identify the customer so that this requirement can be decremented as the stock is issued. Usually a drop-off date is also provided so that the remaining requirement may be automatically deleted after a given terminal date.

(5) *Quantity with a drop-off date*. This can be used to express a requirement that is expected to disappear after a certain date. An emergency requirement for flood relief might be an example of such a requirement; any requirement remaining on the books after the termination of the emergency condition would be automatically wiped out.

c. Requirements may exist for any one of these different types of needs. When the requirements are expressed in time-phased fashion, it is a simple enough matter to slot each requirement in its proper

time period; the total requirement forecast for any period is simply the sum of the individual requirements expected to occur in that period. However, in making requirements forecasts for supply control studies, it is necessary for purposes of levels computations (e.g., safety level, procurement cycle quantity, economic retention quantity, etc.) to express a composite requirement as a demand rate. This has to be done even though the requirement may vary from time period to time period. Before we decide how to do this, however, we have to digress momentarily to discuss program data and program change factors.

d. In our perfect deterministic world, it is assumed that, in so far as recurring demand is

concerned, the rate at which demand will occur in the future is exactly the same as it was in the past. By this we mean the following:

If the AMD for a part was 20 per month during the past when 100 end items were deployed, and the end item deployment in the future is going up to 150, then the expected future demand will be 30, since—

$$\frac{20}{100} = .2 \text{ end item per month}$$

$$150 \times .2 = 30 \text{ per month (AMD)}$$

In supply control studies, of course, the same calculation is done by means of the program change factor (PCF).

$$\frac{150 \text{ ends items in future period}}{100 \text{ end items in base period}} = 1.5 \text{ which is called the PCF}$$

$$\text{PCF No. 1} = \frac{25}{20} = 1.25 \times 1 \text{ 6-month period} = 1.25$$

$$\text{PCF No. 2} = \frac{30}{20} = 1.50 \times 2 \text{ 6-month periods} = 3.00$$

$$\text{PCF No. 3} = \frac{40}{20} = 2.00 \times 2 \text{ 6-month periods} = 4.00$$

$$\text{Avg PCF} = \frac{8.25}{5 \text{ periods}} = 1.65$$

The average demand rate over the entire period is, then—

$$10 \text{ demands per month} \times 1.65 = 16.5 \text{ demands per month}$$

$$\text{Expected future demand} = 20 \text{ per month} \times 1.5 = 30 \text{ per month}$$

Now, suppose we are in the middle of Fiscal Year No. 1 and that the flying hour program (which here will be used as the program factor instead of the end item density) calls for the plane on which the part is used to fly 25 hours per month during the balance of FY No. 1. Suppose the flying hour program in the next fiscal year (FY No. 2) is expected to be 30 hours per month and in FY No. 3, 40 hours per month. If, in the past, this part experienced 10 demands per month and the flying hour program during this base period was 20 hours per month, how would we develop a requirements forecast for the item expressed as a demand rate?

e. For low dollar value items, when an economic order quantity may represent more than a year's worth of stock, the Commodity Command Standard System (CCSS) develops an average demand rate that is assumed to remain constant over the three fiscal years. First an average program change factor is calculated—

f. The forecast of the demand in support of rebuild is handled in much the same way. Here, the assumption in our deterministic world is that the future parts consumption will be exactly the same as

in the average consumption in the past, per unit rebuilt. Thus, if 10 of a part were consumed per 100 end items rebuilt in past rebuild programs, the parts consumption rate is expected to continue as 10 per 100 end items in the future. Thus, if the quarterly program over the next 24 months calls for end item rebuild to be scheduled as follows:

$$100 \quad 110 \quad 110 \quad 120 \quad 60 \quad 80 \quad 80$$

the requirements forecast for each quarter would be—

$$10 + 11 + 11 + 12 + 6 + 6 + 8 + 8 = 72$$

and, for low dollar value items, CCSS would calculate an average monthly requirement to support the rebuild program of—

$$\frac{72}{24} \text{ month} = 3 \text{ per month.}$$

g. Somewhat more complicated rebuild situations can also be handled in the CCSS. Parts consumption data are maintained separately for the different theaters and for different types of rebuild actions such as normal repair of battle or crash damage, etc. If knowledge exists as to whose items are going to be rebuilt and how many are going to be normal rebuild, battle damage, etc., a weighted-average requirement forecast can be projected, as in the following example:

Suppose we have the following quarterly rebuild schedule:

CONUS Normal.....	100	150	200	100	100	100	100	100
Europe Normal.....	100	100	100	100	100	50	50	50
Europe Crash Damage..	50	50	50	50	50	50	50	50

and suppose the parts consumption rates, separately maintained, are—

CONUS Normal, 1 per 100 units rebuilt
 Europe Normal, 1 per 100 units rebuilt
 Europe Crash Damage, 2 per 100 units rebuilt

The expected usage rate per quarter would be—

CONUS Normal.....	1.0	1.5	2.0	1.0	1.0	1.0	1.0	1.0
Europe Normal.....	1.0	1.0	1.0	1.0	1.0	.5	.5	.5
Europe Crash Damage..	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	3.0	3.5	4.0	3.0	3.0	2.5	2.5	2.5

and the composite average monthly requirement to support this planned rebuild program would be—

$$\frac{24.0}{24} = 1 \text{ per month}$$

h. Other types of requirements exist which tend for the most part to continue to occur even though their volume may change from period to period because of changes in level of activity or program. When these can be separately identified and where their volume justifies it, separate requirements forecasts can be made for them as well. Demands associated with Supply Support Arrangements (SSA's) with foreign countries may fall in this category and, if so, would be treated separately. Those requirements forecasts which are expected to recur, even though a varying volumes, are rolled up to form a single rate for supply control study purposes. Thus, if we have the following individual rates, projected as described above:

Recurring Demand—10 per month
 (Nonrecurring Demand) Rebuild Demand—5 per month
 SSA Demand—1 per month

The composite demand rate is 16 per month. In routing supply management review, this rate is assumed to be constant over the forecast horizon of interest. Thus, for the rebuild requirement, expected requirements over a 2-year horizon are included in the rate for reorder point purposes, only requirements expected in the safety level and procurement leadtime and procurement cycle period need be considered in the construction of the composite (recurring) demand rate.

i. Demand rates can be built up in much the same way for items in which the requirements forecasts

are time-phased, as in medium, high, and very high dollar value items under CCSS, except that separate rates are developed for each individual time period in the forecast horizon as called for in the supply control procedure. When demand rates are needed in requirements computations for calculation of safety levels; for example, a composite average rate is arrived at over the appropriate forecast horizon, as in the case of LDV items. For other purposes, however, the requirements projections can be considered period by period and compared to the assets projected to be available during the period to determine whether supply action is required. Nonrecurring requirements expected to occur at particular points in time are added to the recurring demand rate for the appropriate period to give a composite requirement for each period. This technique is also followed in the DODI 4140.24, Budget Stratifications, to develop requirements by month for the simulations-of-buy through the budget years.

5-16. Review Policies

a. There are two basic reasons why reviews are made in supply management.

(1) To see whether future requirements have changed.

(2) To see whether a supply action has to be taken.

These two types of review may be done at the same point in time or with the same frequency, but not necessarily. Indeed, the policies that are followed with respect to the way in which each is triggered and the frequency of triggering can have an important bearing on the effectiveness of the system, from both the cost and supply performance viewpoints.

b. It is customary to think of the first type of review as always done on a fixed frequency basis, called the review cycle. The frequency generally depends on the importance of the item or the dollar value of its demands or both. Review cycles, however, generally represent the maximum time that may elapse between successive requirements reviews. Most modern inventory management systems provide for more frequent triggering of a requirements review. Thus, requisitions, returns, inventory adjustments, etc., are transactions of the first kind that would trigger a requirements review; changes in program data, changes in special requirements, etc., are transactions of the second kind that would also trigger a requirements review.

c. The second kind of review provided for it is the check of the ROP supply position. This is done to see whether any supply action has to be taken and involves the comparison of assets to predetermined action points. Most inventory management systems require that the supply position be checked immediately after a requirements review. However, it is fre-

quently the case in modern inventory management systems that the supply position check may be done more frequently than the requirements review. In one kind of system, this check is done continuously—that is, one or more supply action trigger points may be checked each time a transaction is processed. These are termed continuous review inventory systems. A second kind of system is the periodic review inventory system in which, as the name suggests, the supply position check is done on a fixed frequency such as once a week, once a month, etc. The CCSS is to be a periodic review type of system, although its frequency of review is such (at least biweekly) that it can be thought of something close to a continuous review system. The difference does have to be taken into account, however, as will be shown below.

d. The supply actions that can be triggered when a supply position check is made are of various types. Generally speaking, they fall into the following categories:

- (1) Procurement.
- (2) Excess determination.
- (3) Recall of excess.
- (4) Cutback of procurement and/or repair.
- (5) Expedite.
- (6) Redistribute—either between geographic locations or between stock reservation (e.g., purpose code) accounts.

The basis for such actions is the comparison of assets, either on hand or on order or both, against predetermined requirements levels, which are the subject of the following section.

5-17. Requirements Levels

a. The requirements forecast is subdivided into separate requirements levels for supply management purposes. Quite a few separate levels must be observed by the item manager, as can be seen from Figure 5-5. However, for our purposes here, which is the description of mathematical models that are used in the management of NICP inventory, we can limit our attention to only those levels whose values are generally computed with the aid of these models. These are—

- (1) Funded war reserve requirements.
- (2) Supply support agreements.
- (3) Safety level.
- (4) Repair cycle level.
- (5) Procurement leadtime level.
- (6) Procurement cycle level.
- (7) Requirements objective.

b. It is customary to represent the behavior of an inventory system by means of a sawtooth diagram and, indeed, it is a convenient way to demonstrate the most important relationships that exist.

In a deterministic system, it is assumed, you will recall, that future requirements are known in ad-

FUNDED WAR RESERVE REQUIREMENT
SUPPLY SUPPORT AGREEMENT
VARIABLE SAFETY LEVEL
REQUIREMENTS DETERMINATION TIME REQUIREMENT
REPAIR CYCLE REQUIREMENT
PROCUREMENT LEAD TIME REQUIREMENT
PROCUREMENT CYCLE REQUIREMENT
BALANCE PEACETIME SUPPORT PERIOD BALANCE WAR RESERVE REQUIREMENT

Figure 5-5. Requirements level.

vance and, moreover, that they are known sufficiently in advance so that replenishment actions may be initiated in time to prevent stockouts. Since this is the case, we need not consider safety levels. Further, we can, without distorting any conclusion to be drawn, represent the future requirements as taking place at a known and constant rate. We can now plot the system behavior in sawtooth diagrams. But, in order to insure fundamental understanding of the process, we will do so for the three situations that can exist—that is, when demand in the lead time is—

- (1) Equal to the replenish quantity;
- (2) Less than the replenishment quantity; and
- (3) More than the replenishment quantity.

A continuous review process is assumed.

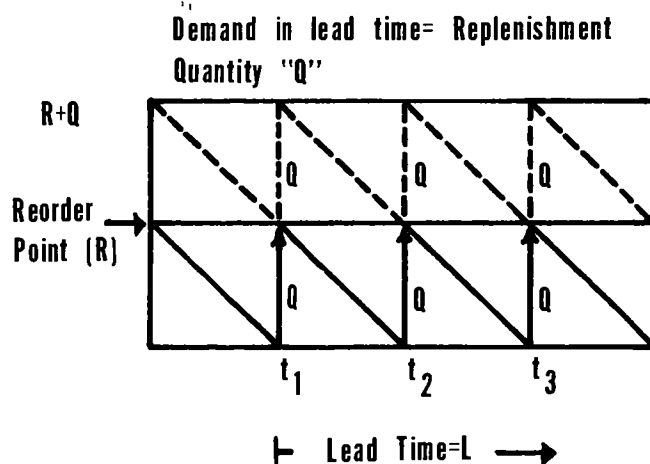


Figure 5-6. Case I review process.

In this diagram, we represent on-hand inventory by a solid line. The sum of on-hand and on-order inventory is represented as a dotted line. The sum of on-hand and on-order inventory is usually referred to as assets in inventory models. This convention is also observed in the Department of the Army, so it will be followed in all subsequent material. Here we see the assets are depleted as demands arrive until the reorder point R is reached at time t_1 . Now a replenishment order Q is initiated bringing the assets up to $R+Q$. At the same time, t_1 , the replenishment quantity Q from the previous order arrives, raising the on-hand inventory back to R . The on-hand inventory is again depleted until time t_2 when assets again reach R and on-hand inventory again reaches zero, at which time the order Q that had been placed at time t_1 arrives.

If we define a demand rate: D =quantity demanded per year, and L =replenishment lead time in years, then we can see the following simple relationships— $D \times L$ =demand in lead time= R and in this instance, $D \times L = Q$ by definition, so that $R=Q$. We also observe that on-hand inventory is always moving between Q and zero, and that assets (on-hand plus on-order), between R and $R+Q$. This leads to the following important relationships:

$$\text{Average on-hand inventory} = I_o = \frac{0+Q}{2} = \frac{Q}{2}$$

$$\text{Average assets} = I_A = \frac{R+(R+Q)}{2} = R + \frac{Q}{2}$$

The term average assets is often referred to as average inventory investment since it represents funds that are tied up not only in on-hand inventory but also in pipeline inventory that has not yet arrived. One other observation can be made, and that is with respect to the frequency of replenishment. If the stock is being depleted at a rate of D units per year and we replenish in Q units each time R is reached, then the replenishment frequency is—

$$D/Q \text{ times a year.}$$

One last observation is made—and this is important—the amount of stock issued between successive replenishments is Q .

c. Now, we can move ahead to the case where the replenishment quantity Q is larger than the demand in the lead time.

Here we see that we replenish at time t_1 when the on-hand inventory drops to R . This raises our assets to $R+Q$. From t_1 to t_2 , which is the lead time L , assets and on-hand inventory are depleted respectively at the same rate D , until time t_2 when the order initiated at time t_1 arrives, raising the on-hand inventory back to Q . Since there is no order outstanding at this time

the assets are also equal to Q . The process continues until time t_3 when assets (which are still equal to on-hand inventory) reach R . Then a new order Q is initiated and the process repeats itself. Now, we can see that the fundamental relationships observed in Case I still hold even though $D \times L$ is less than Q . namely—

$$\text{Demand in the lead time, } D \times L = R$$

$$\text{Average on-hand inventory} = I_o = \frac{0+Q}{2} = Q/2$$

$$\text{Average assets} = I_A = \frac{R+(R+Q)}{2} = R + Q/2$$

and the amount of stock issued between successive replenishments is still Q .

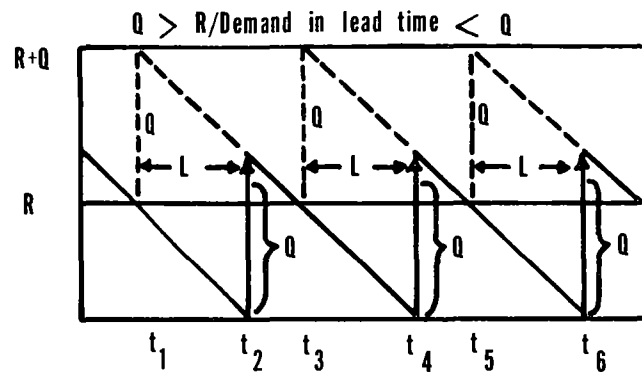


Figure 5-7. Case II review process.

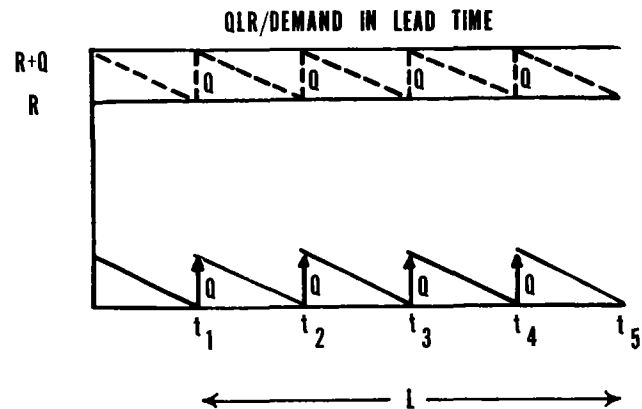


Figure 5-8. Case III review process.

d. We can now take up Case III, in which the demand in the lead time ($D \times L$) is greater than Q . Everything is the same as before but note, now, that the order placed at time t_1 does not arrive until one lead time later at t_5 . In the meantime the assets (on-hand plus on-order) have reached R at times t_2 , t_3 , t_4 , so that when time t_5 is reached, and just before the order placed at time t_1 arrives, we find ourselves with four orders outstanding. Still the same relationships can be observed—

$$\text{Average on-hand inventory} = I_o = \frac{O+Q}{2} = Q/2$$

$$\text{Average assets} = I_A = \frac{R+(R+Q)}{2} = R+Q/2$$

and the amount of stock issued during successive replenishment is still Q . There is one other obvious observation we could have made before but have deferred until now in order to highlight its importance, and that is the average amount of stock due in, which is defined as—

$$I_D = I_A - I_o = R + Q/2 - Q/2 = R$$

e. One further point: we can now define the quantity called the requirements objective, which we will refer to hereafter as the RO .

$$RO = R + Q$$

This is the maximum amount of on-hand and on-order assets. In our deterministic world, when $R = D \times L$, this is merely the sum of the leadtime requirement and the replenishment quantity. When a safety level is provided, it is added to R . If we denote the safety level by S , then—

$$RO = (D \times L) + S + Q$$

We can also introduce another widely used term, the stockage objective, which is defined as—

$$\begin{aligned} SO &= Q \text{ when no safety level is involved} \\ SO &= S + Q \text{ when there is a safety level} \end{aligned}$$

In deterministic systems on-hand would never exceed the stockage objective. Note that we have omitted special on-hand requirements, such as mobilization reserves, from this discussion. When these exist, they are added to SO in the same manner as S .

f. Up to this point, we have been dealing with consumable items. These items, once issued, are gone (returns are omitted from consideration for the time being). Now we wish to extend the discussion to repairable items. A certain fraction of these items, once issued, are expected to return to the NICP as unserviceables. These can be repaired and returned to serviceable inventory. The kind of system we are dealing with thus has two sources of replenishment: procurement and repair, and this complicates matters to some extent. The term “repair” used throughout this discussion refers to the restoration of unserviceables to serviceable condition when the process is under NICP control (i.e., subject to NICP scheduling). As we are using it here, the term embraces overhaul and rebuild also. Before we can go to a sawtooth diagram, some assumptions about repairable items and the policies under which they are managed will have

to be made. The most important ones for our purposes are—

- (1) It costs less to repair unserviceable items (65 percent of the requisition cost) than to buy new ones.
- (2) It takes less time to repair unserviceables than it does to buy and get new ones delivered.
- (3) Repaired items are just as good as new ones.
- (4) Repair actions are scheduled periodically and all on hand at the time are scheduled for repair, except that the quantity scheduled for repair shall not cause the total assets to exceed the requirements objective.

$$O_P = \text{Procurement cycle quantity} = 30$$

(5) Repair actions are done in batches; the time required to restore a batch of unserviceables to serviceable condition is called the repair lead time. These are not the only assumptions that could have been made. They happen to be the ones underlying the policies contained in AR 710-1 and the computational procedures embodied in the DA Form 1974 supply control study. Other assumptions would lead to other policies and computational procedures but we shall confine our attention to these.

g. These assumptions lead to certain relationships. First, when we state that repairs are to be initiated periodically and that all unserviceables on hand at that time are to be repaired, this established the repair cycle quantity. For, if we call the time between initiation of successive repair actions T_R , then Q_R , the repair cycle quantity is—

$$Q_R = T_R \times D_R$$

where the D_R is defined as the net output of the repair process; it represents, in other words, the unserviceables that are returned from the field less those that wash out or are otherwise lost in the NICP repair process.

h. Before stating the important reorder point and requirements objective formulas for repairable items, we must define the assets that should be considered in determining the supply actions to be taken. These are—

- (1) Serviceables on hand.
- (2) Serviceables due in.
- (3) Unserviceables on hand but not yet scheduled for repair.
- (4) Unserviceables already scheduled for repair.
- (5) Unserviceables expected to be returned within the procurement lead time that will arrive in time to be repaired before the end of the procurement lead time.

Now comes a difficult point. In the case of consumables, we defined the procurement lead time requirement as the PLT multiplied by the demand rate during that period. For repairables, however, the effect of unserviceables not yet on hand complicates mat-

ters considerably. The reorder point formula becomes

$$R_P = D_S \cdot L_P + D_R \cdot T_R$$

or, since $D_R \cdot T_R = Q_R$

$$R_P = D_S \cdot L_P + Q_R$$

The requirements objective can now be stated in the expected way

$$RO = R_P + Q_P$$

$$= D_S \cdot L_P + Q_R + Q_P$$

(6) The replenishment rule we will follow states that we:

(a) Initiate repair at a fixed frequency for a quantity Q_R , taking care, however, not to allow the total assets to exceed RO .

(b) Initiate a procurement action for a quantity Q_P when total assets reach R_P , where total assets are defined as the sum of serviceables on hand, unserviceables on hand, due in from procurement, due in from repair, and expected returns of unserviceables that will arrive in time to be repaired before the end of the procurement lead time.

i. This is a rather complicated statement and, indeed, the management of reparables is a complicated process. Its application can perhaps be most easily demonstrated by doing a simple example on a sawtooth diagram. Suppose we have the following item:

$$D_S = \text{Gross demand for serviceables} = 10/\text{month}$$

$$D_R = \text{Net unserviceable return rate} = 5/\text{month}$$

$$L_P = \text{Procurement lead time} = 6 \text{ months}$$

$$L_R = \text{Repair lead time} = 3 \text{ months}$$

$$Q_R = \text{Procurement cycle quantity} = 30$$

$$T_R = \text{Repair cycle time} = 3 \text{ months}$$

$$Q_P = \text{Repair cycle quantity} = 15$$

Using these data and referring to figure 8-9 we see that

$$R_P = (10 \times 6) + 15 = 75$$

$$RO = 75 + 30 = 105$$

If we start at the beginning of Month 1 and assume that a procurement has just arrived, reducing the procurement due in to zero, that a repair action has just been finished, reducing due in from repair to zero, and that we have just finished accumulating a repair cycle's worth of unserviceables, we see that

$$\text{On hand serviceables} = 30 + 15 = 45$$

$$\text{On hand unserviceables} = 15$$

Expected unserviceables that can be repaired within

$$L_P = (L_P - L_R) D_R$$

$$= (6 - 3) 5 = 15$$

$$\text{Total assets} = 45 + 15 + 15 = 75$$

Since total assets are at the reorder point, we initiate a procurement action for a quantity of 30. Also, since

we have just concluded a repair cycle, we initiate another repair order for a quantity of 15. This raises our due in from repair to 15 and drops unserviceable on hand (but not scheduled) to zero. These actions now raise our total assets to

On hand serviceables	= 45
On hand unserviceables	= 0
Due in from procurement	= 30
Due in from repair	= 15
Expected gains from returns with L_P	= 15
Total assets	= 105

and we are now back at the RO .

(1) After 1 month, the on-hand serviceables decrease by 10 to 35, the on-hand unserviceables increase to 5 and the net change in total assets is a decrease of 5 to 100. After 2 months, the on-hand serviceables decrease by another 10 to 25, the on-hand unserviceables increase by another 5 to 10 and the total assets drop to 95. Then at the end of the third month, after serviceable on-hand has dropped to 15, the dues-in from repair arrive; after the new unserviceables arrive, the total assets are—

On hand serviceables	= 30
On hand unserviceables	= 15
Due in from procurement	= 30
Due in from repair	= 0
Expected gain from returns in L_P	= 15
	90

Since we have just finished a repair cycle, we initiate another repair action for a quantity of 15. Note that this doesn't change total assets; all we have done is move the unserviceables from on-hand to due-in from repair.

(2) What happens in Months 4 and 5 is obvious. Finally, at the end of Month 6, the procurement due in arrives as does an outstanding repair order. Our total assets at that time are—

On hand serviceables	= 30 + 15 = 45
On hand unserviceables	= 15
Due in from procurement	= 0
Due in from repair	= 0
Expected gain from return in L_P	= 15
	75

We are again at the reorder point and so place another procurement order for a quantity of 30. Having just completed a repair cycle, we also initiate a new repair order for 15. These actions raise our total assets to 105 (the RO) and the process is ready to repeat itself.

j. It is sometimes found that the reorder point is expressed in terms of the attrition demand—that is, the net “leakage” from the system that has to be replenished from procurement. If this is done, the formulas for R_P and RO become

$$R_P = (D_S - D_R)L_P + Q_R$$

$$RO = R_P + Q_P + L_R D_R + Q_R$$

Inspection will show that these formulas give the same sawtooth diagram if procurement is initiated when serviceable on-hand plus due-in from procurement drops to R_P .

5-18. Levels, Cycles, Times, Rates, Quantities and Frequencies

a. The parlance of supply management can get pretty confusing at times because things can be expressed in different ways. However, a few simple rules, if always kept in mind, will help keep relationships straight.

(1) A requirement can always be thought of as a level.

(2) A level can always be expressed either as a quantity or in time units; e.g., a procurement lead time requirement level may be expressed as a quantity—say 100 units, or as a time—5 months of supply.

(3) A cycle should always be thought of as a period of time; e.g., a repair cycle is the time to repair an item, from the time it is entered on accountable supply records until the repair is completed. Now it can get a little confusing. For example, what is meant by procurement cycle? To be precise, this is the period of time between the initiation of successive procurement actions. When we mean to refer to a requirement, we should say procurement cycle level. Then we should further define whether we mean this procurement cycle level to be expressed as a quantity or as a period of time. Unfortunately, usage over the years has dulled our precision of language and we tend to use the term procurement cycle to mean either, leaving it to the listener or reader to glean from the way the term is used, whether a quantity or time period is meant. The same kind of thing is done with the term level, as in safety level or economic retention level, where either a quantity or a time period may be meant.

b. The following rules are, therefore proposed:

(1) Level—if a requirement is expressed this way, always insist that the appendage be added to specify whether a time period or a quantity is meant; e.g., safety level quantity, safety level months, economic retention level quantity, economic retention level months.

(2) Cycle—if you intend to have this interpreted as a time period, always append time; e.g., repair cycle time (months), procurement cycle time

(months). If you want it interpreted as a quantity, append accordingly; e.g., repair cycle quantity, procurement cycle quantity.

(3) Time—often, a period of time also denotes a requirements level as well, such as procurement lead time or repair lead time. To avoid confusion, always append quantity when you intend to use this term as a quantitative requirement level; e.g., procurement lead time quantity. Avoid the use of terms such as procurement lead time level or repair lead time requirement unless you append either quantity or months to specify what you mean.

c. Now for a few important general concepts: A rate means a quantity per unit time; e.g., 10 requisitions received per month, 100 gallons per minute. A rate is converted to a quantity by multiplying by a time; e.g., 60 requisitions per month $\times$ 6 months = 360 requisitions. 100 gallons per minute $\times$ 2 hours $\times$ 60 minutes/hour = 12,000 gallons. Conversely, a quantity can be made into a rate by dividing by time or into a time by dividing by a rate; e.g., 360 requisitions $\div$ 6 months = 60 requisitions per month, 12,000 gallons $\div$ 100 gallons per minute = 120 minutes. This latter manipulation will be encountered later in this chapter in a very important context when measures of performance are discussed. For example, if we know the average number of requisitions on backorder (which is a quantity) and we know the rate at which requisitions are received, we can determine a customer's average wait, which is a time; e.g.

$$\frac{60 \text{ requisitions on backorder}}{10 \text{ requisitions per day}} = 6 \text{ days average wait.}$$

d. It often helps to check what one is doing in calculations involving quantities, rates, times, etc., by means of what scientists and engineers call dimensional analysis. This means merely doing the operations of elementary algebra on the dimensional units of the terms you are working with. For example, take the gallons per minute illustration that we used above:

$$100 \text{ gallons/minutes} \times 2 \text{ hours} \times 60 \text{ minutes/hour} \\ = 12,000 \text{ gallons}$$

Which is the same as

$$100 \text{ gallons} \times 2 \times 60 = 12,000 \text{ gallons}$$

Observe what we've done. To find the dimensions of the answer, we have used algebraic operations on the dimensions of each element in the computation. Thus, “minutes” in the denominator of the first element cancel “minutes” in the numerator of the last element; “hours” in the numerator of the second element cancels “hours” in the denominator of the last element—leaving only gallons which becomes the dimension of the answer.

e. Some terms that will be of interest to us are dimensionless. For example, the variance of an item's demand is a quantity expressed in units; the item's average or mean demand is also a quantity expressed in units. So, the variance-to-mean ratio of an item's demand is dimensionless.

$$\frac{\text{Variance of Demand (in units)}}{\text{Mean Demand (in units)}} = \text{VMR (dimensionless)}$$

As a matter of fact, it is easy to see now that a ratio, which compares like things, is always dimensionless. So is a percentage, which is merely a ratio multiplied by 100. For example 10 weeks out of stock/52

weeks=.192 (a ratio) and $.192 \times 100 = 19.2\%$ of the time out of stock.

f. Finally, we want to touch on the term frequency, which is a number expressing how often a given event takes place. From this definition, we can see that frequency is a rate. One important frequency we will be dealing with in the next section is the procurement frequency. We can see how this is found by resorting to dimensional analysis; e.g., if the demand rate is D units per year and if we procure Q units each time we buy, then

$$\begin{aligned} \text{Procurement Frequency} &= \frac{D \text{ Units per year}}{Q \text{ units per procurement action}} \\ &= D/Q \text{ procurement actions per year} \end{aligned}$$

Section V. INVENTORY SYSTEMS COSTS

5-19. General

a. In recent years, there has been increasing emphasis within the Department of Defense on the management of activities on a cost-effective basis. Objectives are framed so as to call for the achievement of a particular performance goal at minimum cost—or, alternatively, to maximize the performance achieved for a given amount of expenditure. This emphasis is expected to carry over into the management of the inventory system and those who are responsible for policy and operation decisions affecting the Army's inventory are expected to act with these cost-effectiveness goals in mind. In order to do so, both sides of the cost-effectiveness expression must be taken into account, and to do it well, they must be taken into account quantitatively. This section deals with the cost side—what the relevant costs are in the management of an inventory system and how they enter into policy and operating decisions.

b. This is anything but a straightforward matter. Robert N. Anthony, in his text "Management Accounting Text and Cases" says . . . "There are historical costs, standard costs, original costs, net costs, residual costs, variable costs, differential costs, incremental costs, marginal costs, opportunity costs, direct costs, estimated costs, and full costs. Some of these terms are synonymous; others are almost but not quite synonymous at all; still others, although not synonymous are used by some as if they were synonymous." And he goes on later to caution that the purpose for which the costs are going to be used is the most important consideration in the choice of the type of cost and the manner of its application to the decision process.

c. The major questions to be faced in the management of an inventory system can be boiled down to the following:

- (1) What items should we stock?
- (2) How often should we buy and/or repair

them and, when we do, how much should we buy and/or repair?

(3) Which items should we keep and for how long?

(4) How should we transport them?

(5) How should we control them (e.g., record keeping, physical inventory, issue controls, etc.)?

d. In deciding which costs to consider in reaching decisions on these matters, there are two basic questions involved:

(1) Do the costs in question change when the decision or policy is changed?

(2) Is the change or lack of change different in the short run from what it would be in the long run? There are questions of some consequence in the application of mathematical techniques in the field of inventory management and are discussed in some detail in the following paragraphs.

5-20. Fixed, Variable, and Semi-Fixed Costs

a. In deriving the costs to be used in making decisions, our objective is to find the cost of one unit of the activity subject to control. Thus, if we are concerned with the question of how frequently to buy, we must know how much it costs to process one procurement action; if we are trying to decide whether to ship an item by sea or by air, we must know the cost of shipping one unit of the item a given distance by each mode. However, we have to be extremely careful when determining these unit costs, to exclude all elements of cost that do not vary with the level of activity—the costs that would remain the same, for example, whether we bought 1,000 or 5,000 times a year, or if we shipped 10,000 pounds or 50,000 pounds from CONUS to Europe. Thus, we must try to isolate the fixed from the variable costs.

b. It is, perhaps, easiest to convey the concepts involved here by example. Suppose we consider the

typists who type contractual documents associated with the procurement of replenishment supplies. Clearly, the number of documents they have to type is going to depend directly on the number of procurement actions to be processed. If a decision is made to procure more frequently, more documents will have to be typed and, unless the organization was overstaffed to begin with, either overtime will have to be used or more typists will have to be hired. If, on the other hand, a decision is made to procure less frequently, fewer documents will have to be typed, and, assuming rational staffing practices, some typists can be released or assigned to other productive work that has to be done. Thus, we would be justified in considering the cost of having the contractual documents typed as a variable cost.

c. Now, let's consider the technical data packages that are used to define what it is that is to be bought—the engineering drawings, the specifications, the packaging instructions, etc. Suppose the operating policies of the organization require that these data be kept up to date at all times so that no delay ensues when an item has to be bought. Then, while the technical data packages are an essential element of the procurement documentation, and while it certainly costs money to develop these packages and keep them current, this cost must not be considered at all in our decision on how often to procure under the assumptions made above. So, since this cost remains unchanged whether we buy an item once a year or 10 times a year, we are justified in considering this is a fixed cost in this particular context and thus exclude it from our procurement frequency decision.

d. In between the clearly fixed and clearly variable costs, there are many elements of cost of any activity whose character is partially fixed and partially variable. These are usually called semi-fixed costs. An example might be the salaries of the attorneys in a procurement office—generally one must be on hand even if very few items are bought but the number required does not increase proportionally with the number of procurement actions. A classic example, illustrating the same principle, is a supervisor's salary. There may need to be a very sizable change in workload before the number of supervisors, particularly higher level supervisors, is changed. A supervisor's salary, then, might be considered fixed if the decision is not likely to change workload drastically, but variable if it is.

5-21. Costs in the Short and Long Run

a. Actually, many overhead type costs which may be considered fixed in the short run, are variable in the longer run. Consider the costs of office buildings. There are few decisions which will affect the number of buildings used in the short run. But over the

longer run, the number of buildings is adapted to the number of people, so any decision affecting personnel force size, including frequency of procurement actions, contributes to the required investment in buildings. For decisions having longer run impacts, building cost should be charged based on floor space utilized per person.

b. In the next section, we will discuss the practical techniques available for estimating quantitatively variable costs. Before we do, let us go back to the supervisor's salary as the final illustration of the judgmental, even controversial, conceptual decisions which must first be made. It can be argued that even if the number of higher level supervisors will not change within projected workload changes, part of their salary still should be treated as variable cost. The rationale is that most supervisors act in part as senior task, oriented personnel, working on particularly difficult problems. As the number of people supervised increased, the amount of time that can be devoted to task oriented rather than administrative problems decreases, and there is more of a workload placed on the supervisors. Under this viewpoint, many organizational consolidations, which, by eliminating supervisors appear to eliminate fixed overhead type costs, are not saving as much money as might be claimed.

5-22. Methods of Estimating Costs

a. From this discussion, we know that we cannot for decisionmaking purposes calculate the unit cost of an activity simply by dividing the total cost of its operation by the amount of activity handled. If the cost of running a procurement office is \$1,000,000 a year and the office processes 10,000 buys a year, we cannot say that it costs \$100 for procurement action if the decision under consideration is how often to buy. Nor, if the cost of operating a MAC channel is \$20,000,000 a year and they fly 50,000,000 ton miles, we cannot say that their operating cost is \$.40 per ton mile if we want to decide how much airlift capacity to provide. In both instances, we must first separate the fixed costs and the fixed elements of the semi-fixed costs from the total cost of the activity.

b. This is not/very easy to do. Generally, however, there are three approaches that can be taken.

(1) *Graphical method.* If there are sufficient data points covering a wide enough spread of the activity in question, we can sometimes infer from a graph of the data points what the fixed costs are. For example, if we had data points of the Military Airlift Command total costs for different levels of airlift activity as shown in figure 5-10 we would probably be justified in surmising, by extending the data points back to the Y-axis that about \$15,000,000 of the total MAC costs are fixed. If this is the case, then 100,000,000 ton miles have been flown at a

variable cost of only \$10,000,000 (or, looking at another data point) 150,000,000 ton miles at a variable cost of \$15,000,000. So, if we are interested in what it really costs to fly military cargo for the purpose of determining how much cargo to send by air, the cost we should use in this example is \$.10 per ton mile. It often happens, even when sufficient data points are available for graphic analysis, that the relationship between total cost and the level of activity is not nearly as regular as depicted. Suppose, for example, we graph the following data.

<i>Number of vouchers processed/year</i>	<i>Number of voucher clerks @ \$8,000/year</i>	<i>Number of supervisors @ \$10,000/year</i>	<i>Total cost/year</i>
500	0	1	\$10, 000
1, 000	0	1	10, 000
1, 500	1	1	18, 000
2, 000	1	1	18, 000
2, 500	2	1	26, 000
3, 000	3	1	34, 000
3, 500	4	1	42, 000
4, 000	4	2	52, 000
4, 500	5	2	60, 000
5, 000	6	2	68, 000
5, 500	6	2	68, 000
6, 000	7	2	76, 000
6, 500	7	2	76, 000
7, 000	7	2	76, 000

We cannot draw a smooth curve through these points because the costs jump by discrete increments every time a new employee is added to the rolls. This is called a step function, for obvious reasons. What we can do, however, is approximate the true situation by a straight line to the steps in what can be justified as a reasonable fashion. In this instance, we see that a supervisor appears to be needed no matter how few vouchers are processed so we would be justified in considering his salary as a fixed cost. However, a point is ultimately reached where a second supervisor is needed. This is what now causes the supervisors to be considered semivariable. We get around the dilemma of trying to determine how much of the supervisors' salaries are fixed and how much variable by fitting the dotted straight line through the data starting at \$10,000, as shown in the figure. From this we see that we can process 2,000 vouchers for a variable cost of \$20,000 a year, 3,000 vouchers for \$30,000 a year, so we would be justified in inferring that the variable cost for processing these vouchers is about \$10.00 each.

(2) *Activity analyses.* Very often the data available for determination of variable costs do not contain readings over a wide enough range of activities to allow us to tell how the total costs really change as the level of activity changes. If, for example, the data show costs only over the range 10,000 through 12,000 procurements a year, it is not likely that these data will be very helpful in the determination of variable costs. A technique that can often be useful in its place is activity analysis. This involves

breaking down the operation into its elemental tasks, determining which tasks must be performed and which materials and services must be used, in proportionally greater amount, and those that do not, as the level of activity increases. The costs of those tasks that are activity related are counted, the others excluded. Quite a few tasks will be found to be only partially activity related (these fall in the semi-fixed category) and only the activity related fraction is counted. The total costs of the activity related tasks are then divided by the activity level to find the variable unit cost. An example of this technique will be found in the paragraph below on replenishment costs.

(3) *Time analysis.* Still another method of finding variable personnel costs, which frequently comprise the major portion of the total variable costs, is the actual timing of personnel in the tasks they have to perform. Only those tasks that contribute directly to the output being measured (e.g., requisitions per year) are counted. The variable costs of materials and services used are then determined as in (2) above.

c. One very important point must be mentioned before going into the discussion of costs used inventory models and that is that costs determined by analysis of data covering a given range of activity levels should not be extrapolated beyond that range without a great deal of thought being given to the applicability of the data beyond that range. This is a general principle of management analysis and it is of great importance here. One would be very remiss in assuming in the voucher processing example used above that the variable cost per voucher would still be \$10.00 if 50,000 vouchers a year had to be processed. A principle called economy of scale often comes into play when an activity level crosses certain thresholds. What generally happens is that partitioning of tasks, introduction of labor saving devices, and operating efficiencies generally are resorted to when these thresholds are exceeded and the variable unit costs can suddenly change by very large amounts. The same kind of thing can, of course, happen in the other direction too. Thus, one has to be very careful in making inferences about what these variable costs might be beyond the range of actual observation.

5-23. Marginal Costs

a. A technique that is finding more and more application in inventory management is a tool of economics called marginal analysis. We will make use of this technique in explaining the concepts underlying some of the more advanced inventory models later in the chapter. We start with the concept of marginal cost. This is defined as the additional or

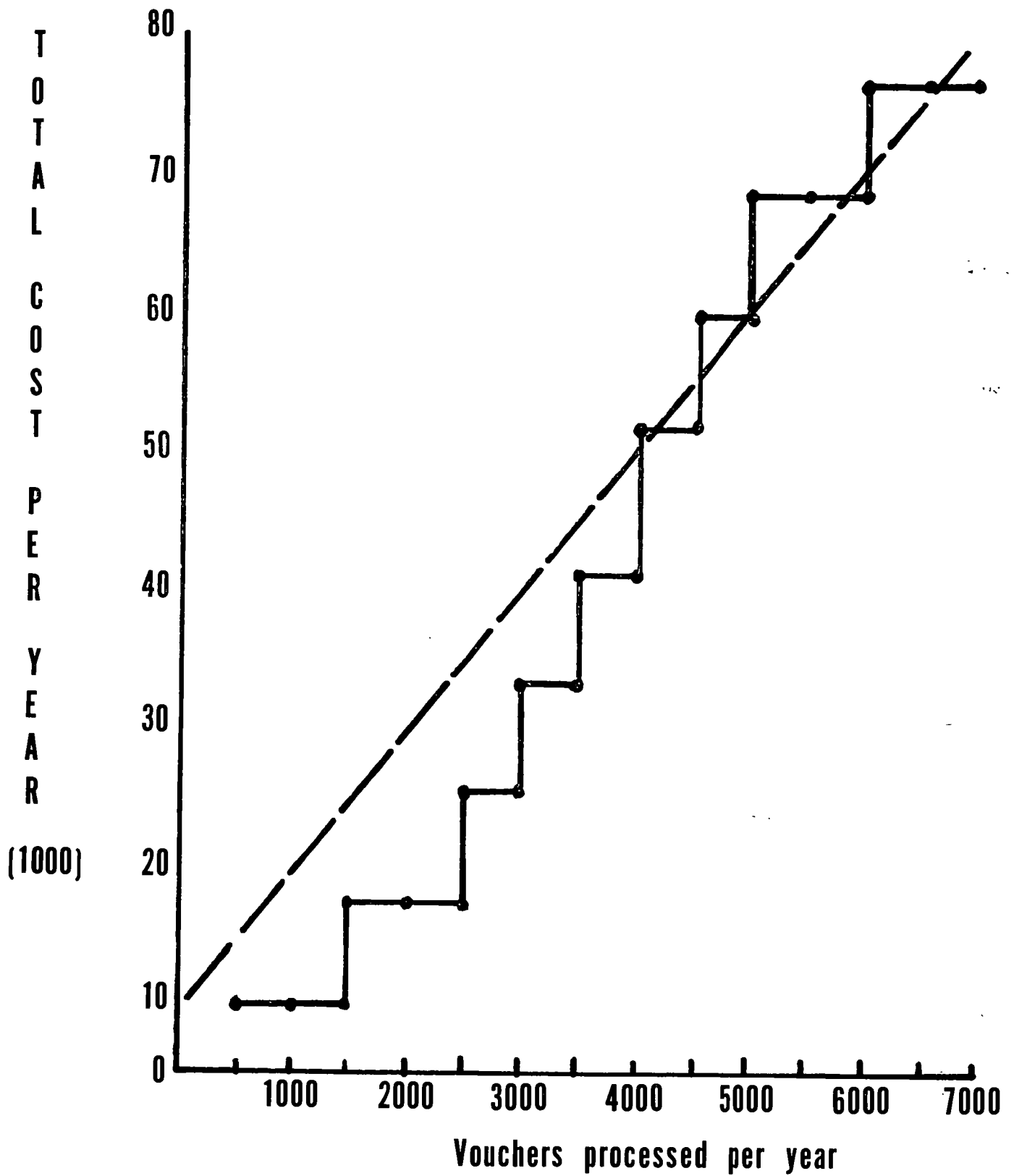


Figure 5-9. Cost of voucher processing activity.

extra cost involved in producing one more item, in using one more unit of a resource, in holding one more item in inventory, etc. The concept can be most simply illustrated by looking at the table below, which represents, say, the cost data of a manufacturer.

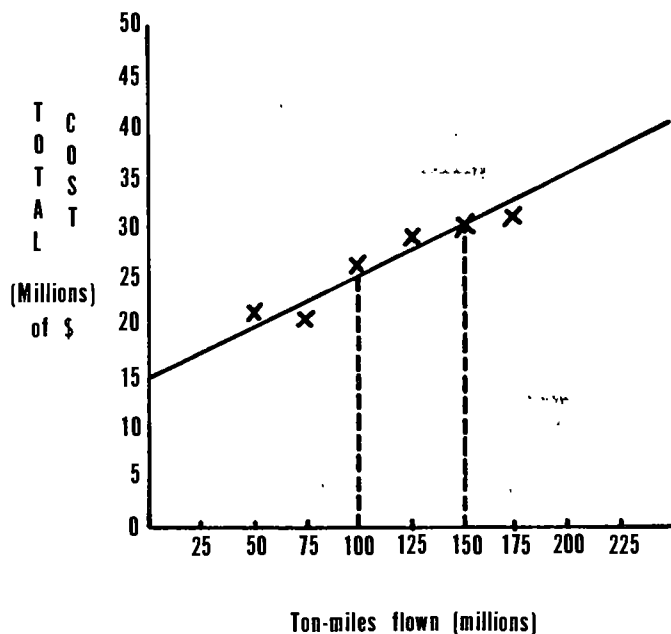


Figure 5-10. Military airlift command costs.

Quantity of output	Total cost	Marginal cost
0		
1	\$4, 000	\$4, 000
2	7, 000	3, 000
3	9, 000	2, 000
4	10, 500	1, 500
5	11, 500	1, 000
6	12, 000	500
7	13, 000	1, 000
8	14, 200	1, 200
9	15, 500	1, 300
10	16, 850	1, 350

The marginal cost can be seen to be the increase in total cost required to produce one additional unit of output.

b. A similar concept exists for marginal revenue. It is simply the increase in gross income obtained by selling an additional unit of product. This is illustrated in the next table.

Units sold	Total revenue	Marginal revenue
0	0	
1	4, 200	4, 200
2	8, 000	3, 800
3	11, 000	3, 000
4	13, 500	2, 500
5	15, 300	1, 800
6	16, 400	1, 100
7	17, 200	800
8	17, 900	700
9	18, 500	600
10	19, 000	500

If we graph the marginal cost and marginal revenue and superimpose a plot the "profit" (defined as revenue minus cost), an interesting fact turns up. It can be shown mathematically that "profit" is maximized at the level of output where marginal revenue equals marginal cost. This is demonstrated on the graph. One can reason, without the aid of mathematics, that this is so by recognizing that so long as marginal revenue is greater than marginal cost, it pays to continue to increase output; when the marginal revenue becomes less than marginal cost, then we have passed the point where increasing output is of increasing benefit. Thus, the point where "profit" is maximized must occur where marginal cost and marginal revenue are in balance.

c. This kind of analysis can be used in making decisions in the management of an inventory. For example, in a subsequent section we will develop the concept of the economic order quantity. This will first be explained graphically, then the EOQ formula will be derived mathematically. Alternatively, we could have done this by applying the principles of marginal analysis. In this situation, as the procurement cycle quantity is increased a unit at a time, the inventory holding cost increases. Conversely, as the procurement cycle quantity increases a unit at a time, the administrative cost of procurement decreases since there are fewer procurements needed each year. If we view this decrease in procurement cost as a "revenue," we can plot this marginal "revenue" against the marginal inventory holding cost for each unit increase in the procurement cycle quantity. The point of their intersection is the economic order quantity—that quantity which, when purchased, will provide the optimal level of operation.

d. We would like now to return for a moment to the marginal cost table. You will note that the marginal cost is shown as decreasing as the units produced increases but that it begins to increase after a while. This illustrates another economic phenomenon that is often encountered—what popularly goes by the name of the law of diminishing returns. In the context of costs, it reflects the fact that fixed costs are present and that, by increasing the quantity produced, we are able to spread, or amortize, the fixed cost over a larger number of units; each additional unit can thus be produced for a cost less than its predecessor. However, this cannot be continued without end because, after a while, the point is reached where the resources provided for production become more and more inefficient for the quantities produced. We eventually reach the point, in other words, where it takes more variable cost to produce the next unit than was needed to produce its predecessor.

e. The point at which the law of diminishing returns begins to take over—the so-called "knee of the curve"—is of great importance to economic planners

and other decision makers who use the tools of economic analysis, for it tells them that it might be advantageous to look for other means of production that would be more efficient for the quantities produced. Thus, in factories, "soft" tooling replaces handmade operations; "hard" jigs, dies, and fixtures supplant "soft" tooling; production line techniques become more and more specialized as various production quantity thresholds are reached. In office activities, functional task specialization, office machines, and computers provide the means by which the production output per unit of variable resource applied is increased. This process is generally referred to as taking advantage of economy of scale or of increasing returns to scale.

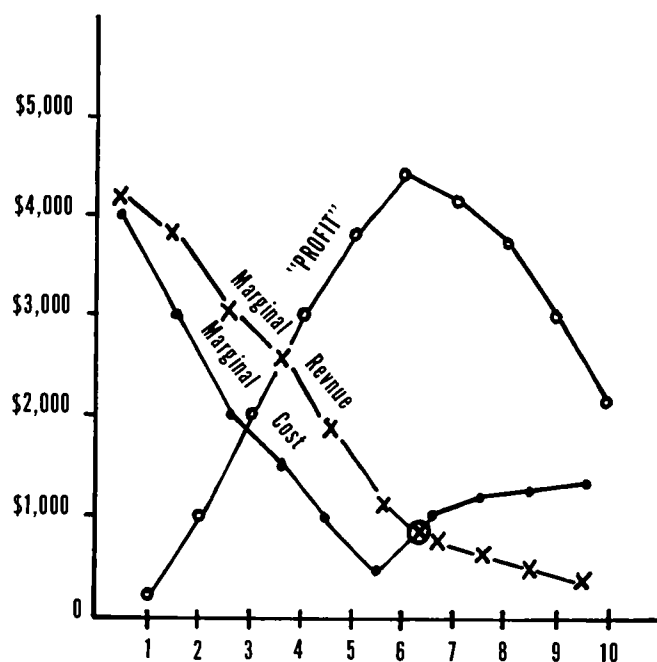


Figure 5-11. Quantity of output.

5-24. Discounting of Costs to Present Value

a. The next economic principle of importance that must be considered is that which has to do with the time preference of money or discounting to present value. In order to achieve a reduction in the cost of operating an activity by introducing economy of scale, we nearly always have to make some investment of capital now in order to achieve cost benefits later. If the benefits are achieved quickly, there is no problem but, more often than not, the economy of scale improvement may not begin to pay for itself until a considerable period of time in the future. When this is the case, it is important that we consider the value of a dollar now compared to a dollar sometime later. The simplest way to think of it is this: Suppose you have an obligation to pay \$100 a year from now. It would be foolish to meet this obligation now, because you could put the dollar in

a savings account earning, say, 5 percent interest so that after a year you could pay off the obligation and have \$5.00 left over. If the obligation doesn't have to be paid until 2 years from now, you could have at the end of the 2 years $\$105 + (\$105 \times .05) = \$110.25$. This you can recognize as compound interest, the formula for which is

$$V_t = V(1+i)^t$$

where

V_t = sum after t years

V = starting value

i = interest rate

t = number of years

In our context, this tells us that an expenditure that can be deferred until some time in the future can be made at the expenditure of fewer dollars today. Thus, if our debt of \$100 is not due until 1 year from now, we could meet this obligation by depositing about \$95 today, because, if $V_t = V(1+i)^t$ then

$$V = \frac{V_t}{(1+i)^t} = \frac{100}{(1+.05)^1} = \$95.23$$

The process of deciding how much a future investment will cost us in terms of today's dollars is called discounting to present value.

b. In what was said above, we related the present value of a future expenditure (or revenue, for that matter, since the discounting principle applies equally as well to the income stream except, of course, that a dollar of income a year from today is worth less than a dollar of income today) to the rate of interest we could earn by investing the money in a savings institution. It would have been possible, however, to invest the money in some other way and earn more than, say a 5 percent interest rate. A favorite example of economists is the entrepreneur who buys \$1.00 worth of grape juice, lets it ferment, and sells it as wine for \$1.50 a year later. Many commercial enterprises take the point of view, in deciding on the present value of a future expenditure or income, that the income from another source that they forego by choosing a particular investment today should govern their decision. Thus, before investing an additional dollar in inventory, they look at what this dollar might earn if put to another use. This value of a foregone opportunity, then, is what they would use as the discount rate in lieu of the interest rate.

c. This latter point of view, interestingly enough, has been adopted by the Department of Defense. In DODI 7041.3, Economic Analysis of Proposed DOD Investments, it is stated that no DOD investment should be undertaken without considering the alternative use of the funds which it absorbs or displaces and that the way to do this is to use an

interest rate that reflects the private sector investment opportunities foregone. The DODI then goes on to refer to analyses that led to the adoption of a rate of 10 percent and directs that this value be used in determining the discounted financial benefits and costs that are expected to result from DOD investments.

5-25. Inventory Replenishment Costs

a. The costs of procuring new items to replenish the inventory fall into two classes, materiel and administrative costs. The materiel cost is the purchase cost of the item itself. It is necessary, of course, to know or have an estimate of this cost to determine the amount of inventory investment required if a certain quantity of the item is bought. Further, the cost of the item will enter into the determination of the economic order quantity. In determining an item's purchase price, we must always keep in mind that we are nearly always interested in knowing what the item will cost the next time we buy. Thus, we must be careful not to use unthinkingly what we paid for the item in the past. Only prices paid when the item was bought in replenishment quantities and under conditions that are likely to obtain when the future replenishment action is initiated should be considered. In procurement actions involving large investments, the advice and assistance of a price analyst should be sought for this purpose.

b. The administrative cost of procurement is needed in many types of inventory models. This type of cost is defined in DODI 4140.39, Procurement Cycles and Safety Levels of Supply for Secondary Item, as including "... those variable direct labor and support costs which began with the output of the requirement notice through the mailing of the contract or order and will also include processing the physical asset into the proper warehouse location after receipt from the contractor. Average contract administration cost will also be a part of the cost to order an item of inventory." The DODI goes on to state that the cost desired is the variable cost per item (NSN) as opposed to the variable cost per contract (one contract may be for several NSN's) and stipulates that the following elements of costs must be determined:

(1) Direct labor/ADP costs per item procured at ICP level.

(a) Processing purchase request to procurement including preparation of documents, item manager review, accounting effort, establishment and maintenance of due-in records, technical coordination, etc.

(b) Purchase, including determination of procurement method, obtaining source lists, drafting and obtaining solicitation, price analysis, selection of contractor, legal review, preparation of contracts, etc.

(2) Direct labor/ADP cost per item administered at a Defense Contract Administration Services Region (DCASR).

(a) Initial file establishment.

(b) Pre-award survey.

(c) Price/cost analysis.

(d) Production follow-up.

(3) Labor benefit costs (per DODI 7041.3).

(a) Personnel benefits (health insurance, life insurance, retirement, etc.) computed at 8 percent of direct labor cost.

(b) Leave entitlements computed at 21 percent of direct labor cost.

(4) Other indirect labor/support cost (both at ICP and DCASR). Includes costs of communications, reproduction, materials and supplies, mail, etc., and costs of personnel support (e.g., Civilian Personnel Office support, etc.).

c. The DODI also states that a minimum of three administrative costs of procurement must be determined, as follows:

(1) For items likely to be procured using the small purchase technique (contracts of \$10,000 or less).

(2) For purchases where a call-type contract is employed.

(3) For purchases where the contract value is likely to be greater than \$10,000 and where negotiated, advertised, or other procurement methods are used.

d. In subsequent sections, the administrative cost of procurement will be used in inventory models, where it plays a direct part in the determination of the optimal level of inventory investment. In this use, the cost is assumed to be linear with the number of procurement actions processed, so that the more frequently we procure the more administrative cost we incur and where doubling the number of procurement actions means doubling this cost. While this is not always true, we will see that this kind of assumption is justifiable in many situations.

5-26. Cost to Hold Inventory

a. *General.* This type of cost is also defined in DODI 4140.39 and the DODI also stipulates how its value should be determined. The DODI defines it as "... the monetary penalty attached to keeping inventory in anticipation of future use." The DODI then says that this cost is assumed to be linear to the average dollar value of on-hand inventory and that its main elements are investment cost, cost of losses due to obsolescence other losses, and storage costs. These are now defined and their manner of determination specified.

b. *Investment Cost.* There are two schools of thought about this element of cost: one thinks of it as the interest the Government has to pay when it bor-

rows money in the short term to invest in inventory; the other view is that the Government investment in inventory is paid for by withdrawing money from the private sector where it could be earning money and that the Government, therefore, should charge itself for the loss of this opportunity at the rate these funds could earn if invested in the private sector. Economic Analysis of Proposed DOD Investments, takes this latter view and DODI 4140.39 states, in turn, that this is the manner in which inventory investment costs will be treated in inventory models. Both DODI cite the cost as 10 percent per year of the dollar value of the average investment as the cost that should be used. DODI 4140.39 closes this section by stating "... Since most order quantity decisions are of a relatively short range nature, this cost need not be discounted." This is a very important statement in recognition of the fact that costs in the short and in the long run have to be treated very differently. This is especially important in the case of holding costs and will be discussed in more detail in a later paragraph.

c. Costs of Losses Due to Obsolescence. Losses due to obsolescence of materiel come about mainly for two reasons: technological advances that make the inventory useless and overforecasting of requirements that results in materiel that is superfluous to needs. When either of these occurs, the materiel is ultimately disposed of at a small fraction of its acquisition cost and a loss is thus incurred. DODI 4140.39 takes the view that both types of situations must be covered in determining what we should charge ourselves for inventory being held because of the expectation that some of it will become superfluous to needs before it is used. The obsolescence loss rate is defined as—

$$\frac{t}{a}$$

where

t = dollar value of transfers to property disposal officers (world-wide)

a = applicable stratified on-hand and on-order assets, as defined in DODI 4140.24, Requirements Priority and Asset Application for Secondary Items.

Details of this computation will not be covered here except to note that a smoothing of the rate is recommended because of the tendency of disposal programs to fluctuate from year to year. Further, the DODI authorizes computation of different rates for different classes of commodities in recognition of the fact that some may be subject to much higher rates of technological obsolescence than others.

d. Costs Due to Other Losses. This element of the holding cost represents losses due to pilferage,

shrinkage, inventory adjustments, etc. It is an expected rate of loss expressed as the percent of average onhand inventory that is expected to be lost per year due to causes of the kind given above. DODI 4140.39 expects each NICP to forecast this expected percent of loss based on past experience. Smoothing, again, is recommended in estimating this rate to avoid undue influence by unusual circumstances. Experience within the DARCOM indicates that this loss rate is quite low, being on the order of 1 percent or less of the average onhand inventory.

e. Storage Costs. These, as the name suggests, are the costs involved in keeping items in inventory. DODI 4140.39 defines this cost element as including not only the out-of-pocket costs incurred in keeping the inventory (warehousing, taking of physical inventories, maintenance in storage, etc.) but also the amortized cost of the storage facilities themselves. Nevertheless, all of the military services and the Defense Logistics Agency have found this cost element to be quite low, again in the neighborhood of 1 percent of the average value of the onhand inventory. The DODI prescribes that a 1-percent figure should be used. To recapitulate, the elements of holding cost and their values are as follows:

	Prescribed by DODI 4140.39	DARCOM Values
Investment Cost.....	10 percent.....	10 percent.
Obsolescence Cost.....	Variable (10%).....	Variable.
Storage Cost.....	1 percent.....	1 percent.
Other Losses.....	Variable.....	Variable.

a. In many inventory models, it suffices to consider costs as being incurred in a linear manner over the entire decision horizon—for example, that if holding costs per year are expressed as—

$$(Q/2 \times u \times C_H)$$

where

Q = procurement cycle quantity

u = unit price

C_H = holding cost per dollar of inventory per year

then holding costs can be calculated by means of that expression for each year; then multiplied by the number of years in the decision horizon to get the total holding costs. However, if the decision horizon is going to extend over more than a few (say, 3) years, this assumption is no longer legitimate. This is particularly the case in models where benefits and costs can occur in different time periods and where it is necessary, then, to discount the benefits and cost streams to present value, as previously described. Moreover, in models for treating decision with long-term cost implications, special treatment of the obsolescence, deterioration, loss, etc., elements of the holding cost term is necessary. Examples of such

models are those dealing with economic retention, procurement termination or cutback and economic airlift; in these models a one-time benefit that can be obtained now (e.g., deobligating contract funds, disposing of stock not needed now, reducing current inventory investment) has to be traded off against costs that would then be incurred year after year into the indefinite future. The modifications that then have to be made to the holding cost term and the reasons for them are now discussed.

b. Think, first, of inventory losses. In short term decisions or in situations where the inventory is constantly being replenished, it suffices to consider that losses will take place at some estimated rate per year. However, in a case where the inventory is not to be replenished, such as in the determination of an economic retention quantity, it is obvious that if we start with, say, 1,000 units and the loss rate is 5 percent a year, the losses we would incur each year would be:

Year	Inventory at beginning of year	Loss during year
1	\$1,000	\$50
2	950	48
3	902	45
4	857	43
5	814	41
Total		\$227

Thus, it can be seen that our losses cannot be calculated by the formula

$$t \cdot e \cdot V$$

where t = number of years

e = loss rate per year

V = starting inventory value

We see that, while the losses during the first year are

$$V \cdot e$$

the remaining inventory is

$$V(1-e)$$

This, multiplied by the loss rate (assumed here to be constant) gives the expected loss in the second year

$$V(1-e) \cdot e$$

and the remaining inventory after the second year is

$$V(1-e)(1-e)$$

It can then be seen that the expected remaining inventory after t years is

$$V(1-e)^t \quad (1)$$

c. Obsolescence must be treated in accordance with the same principle. However, there are some

complications. In treating the loss rate, we assumed that it remained constant year after year. In many instances, however, we would not want to make the same assumption about the obsolescence risk or probability. It seems more natural to think of the probability of obsolescence as being relatively small in the immediate future and increasing as we think further ahead. We would graph it thus:

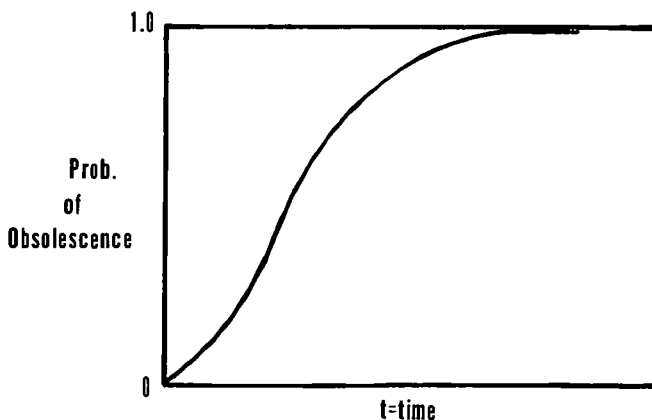


Figure 5-12. Probability of obsolescence.

Note that the curve after increasing for a time must finally change direction and flatten out. This is because the probability of obsolescence becomes 1 as time goes to infinity (every item must ultimately become obsolete so this is a certain event far enough in the future). The obsolescence probability curve must therefore approach 1 asymptotically in the limit. Every item would be expected, under these assumptions, to have its own curve, although all could reasonably be expected to exhibit the same general shape. For the sake of simplicity, however, it suffices to approximate this curve by means of a straight line with slope $=\theta$, the probability of obsolescence in Year 1. Then, the probability of an item not being lost because of obsolescence after t years is

$$(1-t \cdot \theta) \quad (2)$$

d. It follows naturally that only inventory that has not been lost or disposed of is subject to deterioration. Therefore, if we designate the deterioration rate as d (assumed constant over time), the remaining undeteriorated inventory after 2 years would be calculated by multiplying the expected inventory value by $(1-d \cdot t)$.

e. Next, let us consider the storage cost. The same considerations described above apply here also—namely, that we do not incur storage costs for items that have already been lost or disposed of because of obsolescence. So, if we let S_j be the expected storage cost in the j^{th} year and if the item hasn't been lost or disposed by year j , we can estimate S_j to be $s \cdot V$, where s is the storage cost

rate per year. However, if the item is lost or disposed of, no storage costs are incurred and the expected value of the storage costs through the t^{th} year

$$\sum_{j=0}^{t-1} S_j = s \cdot V(1-e)^j(1-j\theta) \quad (3)$$

The summation from 0 to $t-1$ implies that if the item is not lost or disposed of by the beginning of the year, storage costs will be incurred for the entire year. This is a simplifying assumption but has little effect on the final answer.

f. Finally, we turn to the investment cost component of the holding cost. As indicated earlier, we are going to treat this as an opportunity foregone in the private sector and will thus use the value stipulated in DODI 7041.3 (10 percent). However, because we are considering the effect of holding cost on our decision over a longer run, we must apply the principle of discounting all costs to present value, as described above. Thus, each term in the holding cost equation will be multiplied by $1/(1+i)^t$ to accomplish that purpose.

g. Now, we can develop the long term holding cost equation—

$$\text{Holding cost for } t \text{ years} = V - \frac{V_t}{(1+i)^t} + \sum_{j=1}^t \frac{S_j}{(1+i)^j} \quad (4)$$

where

V = current value of the inventory
 V_t = expected value of the inventory after it is held for t years, allowing for deterioration and the possibility of loss or obsolescence

We can find V_t by applying equations (1) and (2) to the starting value of the inventory,

$$V_t = V(1-e)^t(1-t\theta)(1-dt) \quad (5)$$

and adding the storage costs gives us—

Holding cost over t years =

$$V - \frac{V(1-e)^t(1-t\theta)(1-dt)}{(1+i)^t} + sV \sum_{j=0}^{t-1} \frac{(1-e)^j(1-j\theta)}{(1+i)^j} \quad (6)$$

if we have the following values of the elements of the holding cost

e = 2 percent	d = 5 percent	i = 10 percent
θ = 5 percent	s = 1 percent	(total = 23 percent)

Then the holding cost rate over t years comes out as follows

t	$H(t)$
2 years	38 percent
4 years	63 percent
6 years	80 percent
8 years	90 percent
10 years	97 percent

Contrast this with the $H(t) = 230$ percent that would be obtained if we had erroneously projected the holding cost as a straight line cost over the 10-year period. Use will be made of this formulation in subsequent sections where costs and benefits of a decision have to be compared over a long period of time.

5-28. Backorder Costs

a. Backorder costs fall into two categories. Those of an administrative nature (extra correspondence with customers, data research, expediting, etc.) and those that are performance related. The administrative type of cost presents no special problems since it can be estimated in accordance with the precepts described earlier. The performance related costs, however, are a different matter for they involve intangibles that are extremely difficult to evaluate in a quantitative sense. In the commercial world, for example, the performance related cost of a backorder lies in lost sales. Customers are likely to become impatient if they are unable to get what they want right away; more important, there is always the chance that a customer whose order is backordered may cease to be a customer in the future. Thus, in commercial life, it is not only the revenue that is potentially lost on a given backorder but also the potential loss of future revenue that concerns the profit center. This latter aspect of the backorder cost is, of course, extremely difficult to foretell although there are instances where commercial firms have worked out schemes to do so. If this can be done in a realistic way, then one can treat the backorder cost in an explicit fashion and use inventory models of the kind described in the following section to find the optimum decision rules under which to operate.

b. In the military services, however, the intangible portion of the backorder cost is even more difficult to deal with. We must face the "for the want of a nail" possibility—the possibility that a repair part on backorder may deadline a tank, that the lack of the tank may affect the course of a battle, and so on. Even so, some attempts have been made in the military to link the cost of a backorder to the consequences felt because of the backorder. The Navy, for example, has used a model in connection with initial provisioning of the Polaris Fleet Ballistic Missile System that took the daily backorder cost of a part to be the cost of the next higher assembly rendered inoperable because of the part backorder, the cost being amortized over the assembly's expected useful life. The rationale

here was that the way to avoid the consequences of a part backorder was to buy an extra next higher assembly—the size of that cost penalty, then, served as the mechanism for offsetting investment cost in the inventory model that was used to determine part stockage levels.

c. For the most part, however, military specifications of inventory models seek to avoid having to deal with the backorder cost explicitly. First, the assumption is made that the performance related portion of the backorder cost far outweighs the administrative portion, so that if we deal with the former, we can ignore the latter. Second, and more important, it is possible to bypass the need to quantify the backorder cost if one is willing to specify what kind of supply performance he wants to achieve. When this is done in inventory models, it then becomes possible, by application of appropriate optimizing techniques, to achieve this performance at minimum operating cost.

d. Even though backorder costs may be imputed rather than explicit, we may want to distinguish one kind of backorder from another. Thus, in DODI 4140.39, imputed backorder costs for an NSN may be weighted by the NSN's essentiality. When this is done, NSN's of a higher essentiality are assessed a higher penalty cost for backorders incurred, the penalty being proportional to the difference in the essentiality rating.

e. The need to distinguish between different backorders also arises in another context. Take the case of requisitions coming into the NICP bearing different priority designation. Even on the same NSN, we would like to distinguish between backorders for high priority requisitions and backorders for low priority requisitions. This can be done by assuming that a higher penalty cost prevails for high priority requisitions that are backordered. This manner of weighting backorder costs forms the basis for the stock rationing model described in Section VII by which stock is reserved after it is depleted to a certain point in anticipation of future high priority demand even though the requisitions for low priority customers may have to be backordered.

f. Finally, backorders costs, even though imputed and whether or not they are weighted, may be meas-

ured in somewhat different ways. The most commonly encountered distinctions are—

Backorder cost per unit backordered

Backorder cost per requisition backordered

Backorder cost per unit backordered per unit time

Backorder cost per requisition backordered per unit time

The method of counting backorder costs has a significant effect on requirements levels computed by means of optimizing inventory models. This will be discussed in the section on probabilistic inventory models.

5-29. Other Inventory System Costs

Costs to replenish and hold inventory and the cost of backorders, real and/or implied, are extensively used in inventory management models applied particularly to decisions on what items to buy, when, and in what quantities. These, of course, are not the only decisions an inventory manager has to make. Others involving questions of which items to stock or not to stock, which items to repair, when and in what quantities, which items to keep in which depots, which items to ration, and many others, are frequently complex, and are equally amenable to quantitative analysis in many cases provided the most pertinent costs can be identified and estimated. Some of these decision models will be described in subsequent sections of this chapter and in each case the types of cost needed for rational decision-making will be mentioned. The same principles as were just described apply in each case. All will contain fixed, semifixed, and variable elements; all will be found to behave in accordance with the law of diminishing returns and to lend themselves to economy of scale; and all will require discounting to present value when used in decision models having long run consequences. Those who use these models should bear these facts in mind and consider, as well, the precision to which these costs can be estimated. Although it will frequently be found that fairly sizable amounts of error in estimation of costs can be tolerated in many decision models, it is well for the manager to know how much error the costs he is using contain and what effects these errors can have on his final decision.

Section VI. THE ECONOMIC ORDER QUANTITY CONCEPT

5-30. Equivalence of Costs

The notion of equivalence of cost is fundamental to all that follows. By equivalence of costs, we mean that one dollar's worth of cost is worth one dollar, no matter which activity incurs the cost. This may seem like a self-evident statement but, in fact, it is not. It means, for example, that one dollar's worth of procurement activity has the same value as one dol-

lar's worth of inventory holding costs, even though procurement activity costs, which are largely personnel-related, are paid for by OMA funds and inventory holding costs, which depend on the dollar value of the inventory, entail the use of Army Stock Fund or Procurement Appropriation funds. While it is not within the purview of an item manager to make use of more or less of one kind of money in place of the other, the inventory models we are about

to discuss make the assumption that this can be freely done. In fact, all these models look at the potential cost savings that might be achieved by changing the amount of one kind of resource used versus another. If the amount of resource usage can be expressed in terms of dollar costs, then the models, under the cost equivalence assumption, can examine the sum of the costs of all the resources that are being varied to find that set of resource costs whose sum is a minimum. This process of varying the amounts of resource usage to see how the total costs change is generally called trade-off analysis. When the search for the set of resource utilization values that minimizes total costs is done by formal mathematical manipulation, the process is generally called optimization. It is important to observe that both processes depend on the notion of cost equivalence, for without this there is no basis for comparing the relative worth of each type of resource whose use is under consideration. This holds true not only for those activities whose costs can be estimated, but also for those components of the total costs (such as backorder costs, for example) whose values may only be inputted. In other words, a dollar's worth of inputted costs in these models is worth exactly the same amount of a dollar's worth of any other kind of cost.

5-31. The Economic Order Quantity Model

a. We are now ready to develop the first of our inventory models, the economic order quantity (EOQ) model. Remember that we are still in our deterministic world where everything that is to happen in the future is known. Among the things known about the future are the costs of managing our inventory system and how these costs change as we vary our decisions. The assumptions we must make in order to develop the simplest EOQ model (in addition to the one about our knowledge of the future) are—

(1) The variable administrative cost of procurement is linear in the number of procurement actions processed (i.e., the variable administrative cost is the product of the number actions processed and the cost per action).

(2) The cost of holding inventory is proportional to the dollar value of the average on-hand inventory.

(3) The costs we are concerned with are stationary; that is, they remain at a constant level in the future. Let us assume the following values of our parameters of interest:

u = Unit Cost of the item = \$10 each
 C_P = Administrative Cost of Procurement = \$100 per action

C_H = Inventory Holding Cost = 20% per year of the dollar value of the on-hand inventory
 D = Demand Rate = 100 units per year

We want to find the economic order quantity to purchase; that is, the quantity we should buy in order to incur the minimum total variable cost per year. The total variable cost per year (we will denote this as TVC) is defined as follows:

TVC = Cost of the item + administrative cost of procurement + cost of holding the inventory (1)

If we call the purchase or order quantity Q , we can particularize equation

TVC/year = Unit cost of the item $\times$ demand rate per year
 + cost per procurement action $\times$ no. of actions per year
 + cost to hold $\times$ dollar value of average on-hand inventory

or

$$TVC/\text{year} = (D \times u) + \left(\frac{D}{Q} \times C_P\right) + \frac{Q}{2} \times u \times C_H \quad (2)$$

Now we observe that the first term of equation (2) does not have a Q in it; in other words, the dollar value of the total inventory used per year does not depend on how frequently we buy. This being the case, we may ignore this cost in finding the optimum.

b. Before going into any mathematical development, let us first tabulate the TVC if we were to buy in lots of 50, 75, 100, 125, 150, and 200, and graph the results (fig 5-13).

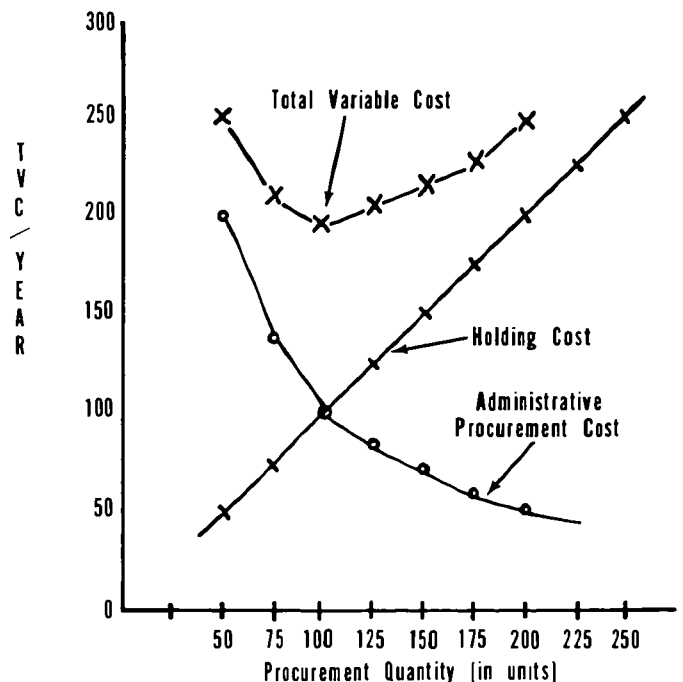


Figure 5-13. Procurement quantity (in units).

Q	Admin. procurement cost	Holding cost	TVC
50	$2 \times \$100 = \200	$25 \times \$10 \times .20 = \50	\$250
75	$1.33 \times \$100 = \133	$37.50 \times \$10 \times .20 = \75	\$208
100	$1 \times \$100 = \100	$50 \times \$10 \times .20 = \100	\$200
125	$.8 \times \$100 = \80	$62.50 \times \$10 \times .20 = \125	\$205
150	$.67 \times \$100 = \67	$75 \times \$10 \times .20 = \150	\$217
200	$.50 \times \$100 = \50	$100 \times \$10 \times .20 = \200	\$250

Note that the TVC curve is formed by adding the administrative procurement cost per year to the inventory holding cost per year. We can see that the procurement quantity Q that causes the TVC per year to be a minimum is in the vicinity of 100. Note that the TVC is a minimum when the inventory holding cost equals the procurement cost; this is always the case for our simple EOQ model as we will see from its mathematical derivation.

c. The differential calculus is used to find the point on the TVC curve where TVC is a minimum. This is the point on the TVC curve where the first derivative of the TVC equation is equal to zero. Restating equation (2)

$$TVC/yr = D \cdot u + \frac{D}{Q} C_P + \frac{Q}{2} C_H \cdot u \quad (2)$$

We will now differentiate TVC with respect to Q (what we are doing here is finding that point on the TVC curve where its tangent is zero, this being the point where the curve changes direction—its point of inflexion—and where its value is therefore a minimum).

$$\frac{d(TVC)}{dQ} = 0 - \frac{D}{Q^2} C_P + \frac{C_H \cdot u}{2} \quad (3)$$

Setting

$$\frac{d(TVC)}{dQ} = 0,$$

we get

$$0 = -\frac{D}{Q^2} C_P + \frac{C_H \cdot u}{2} \quad (4)$$

$$\frac{Q^2}{D C_P} = \frac{2}{C_H \cdot u} \quad (5)$$

$$Q^2 = \frac{2 D C_P}{C_H \cdot u} \quad (6)$$

$$Q = \sqrt{\frac{2 D C_P}{C_H \cdot u}} \quad (7)$$

This is the classic economic order quantity formula, which is also called the economic lot size or Wilson formula. Now, going back to our original parameter values, we can solve directly for the procurement quantity that minimizes our TVC . Using equation (7)—

$$Q = \sqrt{\frac{(2)(100)(100)}{(10)(.2)}} = \sqrt{1000} = 100 \text{ units}$$

*Going back to paragraphs 8–15 through 8–18 we see that—

$$\text{Procurement frequency} = \frac{D}{Q} = \frac{100}{100} = \text{once a year}$$

If we call the Q in units our Procurement Cycle Quantity, the Procurement Cycle Time is—

$$\frac{\text{Quantity}}{\text{Demand Rate}} = \frac{100 \text{ units}}{100 \text{ units/year}} = 1 \text{ year (of supply)}$$

5-32. Upper and Lower Limits on the EOQ

a. So far, so good. Now, however, we must begin to introduce complications that are present in the real inventory system which, unfortunately, complicate the simple EOQ formula we have just derived. First, let us suppose that the item for which we want the EOQ costs only \$.10 instead of \$10.00 then

$$Q = \sqrt{\frac{(2)(100)(100)}{(.10)(.20)}} = \sqrt{1000000} = 1000 \text{ units}$$

This is fine, except that when one translates this quantity into years of supply, we see that 1,000 units represents 10 years of supply. This should give us pause, for 10 years is a long time. Remember the assumptions that underlie the simple EOQ model; do we expect the demand to remain unchanged, do we expect the procurement costs, the holding cost, the item's unit price to remain stationary over such a long period of time? Prudence says perhaps not, but as will be seen later in this section, arbitrary reductions of EOQ can lead to surprising results.

b. There is another reason, however, that could cause us to buy less than the EOQ and this is an item's shelf life. One way to handle this situation is to increase the item's obsolescence risk, which would cause the EOQ to decrease. A simpler way is to merely constrain the EOQ so that the months of supply does not exceed the shelf life limitation. If, for example, an item's demand rate is 100 units per year and its shelf life is 6 months, we would never want to buy more than 50 units. We must be careful, however, that we understand what the shelf life limitation really means. If the item is going to be issued by the NICP to a customer who is going to keep it on his shelf, then the expected time on his shelf must be considered.

c. Next, let us look at an example which takes us in the other direction. Suppose the item we are interested in has an annual demand rate of 10,000 units and that its unit price is \$1,000. (C_P and C_H) unchanged;

$$Q = \sqrt{\frac{(2)(100)(10000)}{(1000)(.2)}} = \sqrt{10000} = 100 \text{ units}$$

Now, however, 100 units represent only 1/100 or a year's supply of 3.65 days. Do we want to buy any item that frequently? Probably not. Again, it is com-

mon practice in industry and Government to place a constraint on the low side of the EOQ as well. DODI 4140.39 says, for example, that the minimum EOQ shall be 3 months of supply.

d. It is interesting at this point to digress for a moment to comment on the procurement frequency and what it depends on when the EOQ principle is applied. Recall that the procurement frequency is defined as D/Q . Starting with equation (7), it is easy to show (we leave the algebra to the reader) that—

$$D/Q = \sqrt{\frac{u \cdot D \cdot C_H}{2C_P}} \quad (8)$$

Note that $u \cdot D$ is the dollar value of demand per year so that as $u \cdot D$ goes up, procurement frequency increases and as $u \cdot D$ goes down, procurement frequency decreases. Thus, we see that the items with large EOQ's in terms of months of supply are the low dollar value demand items; those with small EOQ's in terms of months of supply are the high dollar value demand items. Note also that EOQ and "big buy" are not synonymous. We sometimes hear item managers assert that EOQ principles cannot be applied on their items because they "cannot afford it." In actual fact, the procurement cycle investment for a given catalog of items may be less when EOQ principles are applied than when fixed procurement cycles are used. How individual items will fare can easily be found out by applying equation (8).

e. Now let us return to the item whose EOQ calls for a procurement every 3.65 days. There is another point to be made here. While it seems obviously wrong to buy this item so often, the lower limit of 3 months called for in DODI 4140.39 may not always be the best course of action either. Since items affected by this lower constraint are the high dollar items, it is possible that many of these items might lend themselves to "requirements type" contracts, under which variable delivery quantities could be called for monthly, geared to the month's requirements. Since contractual obligations need cover only the immediate future, the inventory investment and on-hand inventory can be kept low, and the frequent incidence of administrative procurement cost can be avoided. As a general rule, every item whose EOQ calculation results in the 3-month minimum constraint being reached should be considered a prime candidate for special contractual action.

5-33. Effects of Multiple Administrative Costs of Procurement on EOQ Calculation

a. In paragraphs 8-3 through 8-8, it was indicated that the administrative cost of procurement, C_P , varies with the dollar value of the contract. But the EOQ formula of equation (7) provides for only one value of C_P . How do we handle this? The procedure

is straightforward. One has to first compute the EOQ using the lowest C_P , then see whether the contract value for the quantity is less than the lowest bound, in this case \$2,500. If it is, this is the EOQ and our calculation is finished. However, if the EOQ dollar value is greater than the \$2,500 bound, this is an infeasible solution since we cannot buy that quantity for a C_P of \$125. So, we calculate a new EOQ, using now the second value of C_P in this case \$450. If the EOQ dollar value is less than \$10,000, we have a feasible solution but we are not yet sure whether it is optimal for it is possible that a lower total variable cost per year might be obtained if we were to buy exactly \$2,500 worth. Therefore, it is necessary for us to calculate the TVC for the calculated feasible EOQ and for a buy quantity worth \$2,500. We do this by means of the TVC formula given in equation (2). (The first term can, of course, be omitted for this calculation.) The quantity whose TVC is lower then becomes our EOQ. If we found no feasible EOQ using the second C_P value (\$450), then we repeat this procedure using the highest C_P value (\$745). Again, even though we find a feasible EOQ within this cost region, we must check the TVC of this EOQ against the TVC obtained if we were to order exactly \$10,000 worth.

b. While the procedure is straightforward, it is also cumbersome. Thus, it is generally entrusted to the computer. In order to illustrate the procedure, however, we give the following example. We will restrict ourselves to two values of C_P since this is sufficient to illustrate the principle. To keep the arithmetic simple, we will use

$C_{P1} = \$100$ for procurement quantity worth
\$2,500 or less

$C_{P2} = \$400$ for procurement quantity greater
than \$2,500

We can start with a previous example where

unit price = $u = \$10$
demand rate = $D = 100$ units per year
holding cost = $C_H = .20$

Starting with the lower procurement cost C_{P1} , we see that the EOQ is

$$Q = \sqrt{\frac{(2)(100)(100)}{(10)(.20)}} = 100 \text{ units}$$

The cost of 100 units is \$1,000. Since the dollar value of the order quantity is less than \$2,500, this is a feasible optimal solution. This would be our EOQ and we need go no farther.

c. Of course, this won't always happen. Suppose the item costs \$100 rather than \$10.

First, find the EOQ at $C_P = \$100$

$$Q = \sqrt{\frac{(2)(100)(1000)}{(100)(.2)}} = 100 \text{ units}$$

Value of contract = $100 \times 100 = \$10,000$ so that this EOQ is infeasible.

Next, find the EOQ at $C_P = \$400$

$$Q = \sqrt{\frac{(2)(400)(1000)}{(100)(.2)}} = 200 \text{ units}$$

Now, find the TVC for the EOQ of 200 units and a buy of 25 units, which is the largest quantity we could buy at $C_P = \$100$.

$$\begin{aligned} TVC_{200} &= \left(\frac{1000}{200} \times 400\right) + \left(\frac{200}{2} \times .20 \times 100\right) \\ &= \$2000 + \$2000 = \$4000 \text{ a year} \end{aligned}$$

$$\begin{aligned} TVC_{25} &= \left(\frac{1000}{25} \times 100\right) + \left(\frac{25}{2} \times .20 \times 100\right) \\ &= \$4000 + \$250 = \$4250 \text{ a year} \end{aligned}$$

So our decision should be to buy the EOQ of 200 units.

5-34. Quantity Discounts

a. Sometimes a manufacturer will sell an item at a lower price if a large quantity is bought. This usually reflects the fact that there is some amount of fixed cost incurred by the manufacturer; the larger the quantity he sells, the lower the fixed cost per unit sold and thus the lower his selling price can be. The fact that he is willing to offer a price discount if we increase our purchase quantity has to be taken into account in our EOQ calculation when this fact is known. Let us go back to our \$10 item with the demand rate of 100 units a year. Let $C_H = .20$ and $C_{PI} = \$100$ for contract value less than or equal to \$10,000 $C_P = \$400$ for contract value greater than \$10,000 as before. Suppose, however, that the contractor tells us that he'll give a 10 percent discount if we buy 150 or more. How much should we buy?

b. We know from our previous example that the EOQ was—

$$Q = \sqrt{\frac{(2)(100)(100)}{(10)(.20)}} = 100 \text{ units}$$

when the unit price is \$10. We now must repeat the computation with a unit price of \$9.50

$$Q = \sqrt{\frac{(2)(100)(100)}{(9.50)(.20)}} = 108 \text{ units}$$

But this is infeasible, because the unit price for anything less than 150 units is \$10. To determine whether to take advantage of the manufacturer's offer, we therefore compare the TVC for our buy of 100 units at \$10 versus the alternative of buying 150 units at \$9.50 each. In making this comparison we

must use all the cost components in equation (2) since the unit cost of the item times demand rate per year now depends on Q . It must be now considered as well as holding costs and administration costs of procurement.

$$TVC_U = DXU + D/QXC_P + Q/2 XU \times C_H$$

$$\begin{aligned} TVC_{\$10} &= 100 \times \$10 + \left(\frac{100}{100} \times 100\right) + \\ &\quad + \left(\frac{100}{2} \times 10 \times .20\right) = \$1200.00 \text{ a year} \end{aligned}$$

$$\begin{aligned} TVC_{\$9.50} &= 100 \times 9.50 + \left(\frac{100}{150} \times 100\right) + \\ &\quad + \left(\frac{150}{2} \times 9.50 \times .20\right) = \$1159.17 \text{ a year} \end{aligned}$$

c. It may happen that the manufacturer's price schedule is expressed in a somewhat more complicated way. He may, for example, cite different unit prices for different quantity ranges, as in the following example:

Quantity:	Unit price
Less than 100	\$10.00
101-500	9.95
501-1,000	9.60
Over 1,000	9.00

In this situation, we would have to compute the EOQ for each unit price starting with the lowest, discarding those that are infeasible, remembering that they may be infeasible either because they violate the quantity discount condition or the procurement cost condition. The TVC then has to be calculated for each remaining feasible EOQ and for the quantities at the procurement cost boundaries or price discount boundaries (i.e., 101, 501, 1,001). Procurements of some commodities like subsistence, clothing, and petroleum may involve complications like these multiplied many times over. There may be dozens of bidders, each with known quantity discount schedule, most with restrictions on the quantities they can furnish, etc. Requirements may be time-phased and multiple depot destinations may also be involved, so the location of the manufacturer with respect to destination location becomes an important factor in bid evaluation because of the transportation costs. In such cases, the problem of how much to order from which manufacturer to ship to which depot during which time period become so large computationally that the special techniques of mathematical programming have to be used. The Defense Logistics Agency, in particular, devotes a lot of attention to development of efficient computer programs for this purpose.

d. Consideration of quantity discounts can involve a lot of extra computational work. Moreover, there

is no standard way in which manufacturers present their price schedules.

5-35. Effects of Suspect Data on EOQ Results

a. From earlier sections, we see that the estimation of the costs used in EOQ calculations is not an exact science and that it is possible that the costs we use may be erroneous. If this is the case, we have reason to be concerned about the effects of using erroneous cost data in the TVC incurred when we buy under EOQ policies. Also, the fact that our estimates of demand rates may be erroneous is a further cause for concern. There is a very useful formula for examining the consequences of error which is as follows:

$$\frac{TVC^1}{TVC} = \frac{r_q + 1}{2\sqrt{r_q}}$$

where

TVC is the optimal TVC when correct data are used

TVC^1 is the TVC value when incorrect data are used

and r_q is

$$\frac{\frac{C_p^1}{C_p} \cdot \frac{D^1}{D}}{\frac{C_H^1}{C_H} \cdot \frac{U^1}{U}}$$

where the primed variables are the incorrect ones.

b. Suppose, then, we use a value of C_p that is twice as great as it should be (e.g., our true cost of procuring for a contract value of less than \$2,500 is really \$50 instead of \$100). How does this affect the TVC assuming all other parameter values are correct?

$$C_H^1 = C_H \text{ and } U^1 = U$$

$$r_q = \frac{\frac{100}{50} \times 1}{\frac{C_H^1}{C_H} \times \frac{U^1}{U}}$$

then

$$\frac{TVC^1}{TVC} = \frac{2+1}{2+\sqrt{2}} = 1.06$$

This means that using an incorrect C_p of \$100 instead of the correct value of \$50 results in only a 6 percent increase in TVC over what TVC should be.

c. Let's look at an error in the other direction. Item managers frequently express concern about buying EOQ because of possible obsolescence. The EOQ does, of course, provide for obsolescence in the holding cost but suppose we have made an error in estimating this factor and that the holding cost we use is only $\frac{1}{2}$ of what it should have been. Applying the same formula, we see that

$$r_q = \frac{1 \times 1}{\frac{1}{2} \times 1} = 2$$

then

$$\frac{TVC^1}{TVC} = \frac{2+1}{2+\sqrt{2}} = 1.06$$

So, again, the consequences are slight. The increase in TVC over what they should have been again amounts to only 6 percent.

d. The effect of errors in forecasting the demand rate on the EOQ is a much more difficult topic. If we are concerned with EOQ's that would last for a relatively short period of time we could apply the previously used error effect formula with confidence. The fact of the matter, however, is that EOQ may represent 3, 4, or more years of demand and item managers justifiably are concerned about their ability to project a demand rate that far into the future, not so much because the forecast error may be large but because the item may become completely obsolete before the EOQ is used up. The problem with the EOQ formula is that it assumes repetitive procurements into the indefinite future. We could help matters, perhaps, by applying the long-term holding cost concept in calculating the EOQ but the fact still remains that, if there is a strong possibility that the item may not be procured again, we are probably better off to place an arbitrary upper limit on the procurement quantity.

5-36. Inventory Turnover Rates

a. An inventory turnover rate is defined as the number of times a year the inventory is sold. More precisely, we define it as the average on-hand inventory divided into the annual sales, or

$$\text{Turnover rate} = \frac{D}{Q/2} \quad \text{when no safety level is used or}$$

$$\frac{D}{S + Q/2} \quad \text{when a safety level is present}$$

Now we are faced with an anomaly. We often hear of business men and military logisticians striving for high turnover or rapid turnover of their inventory. Is this goal consistent with our EOQ objectives? The answer, of course, is frequently no! Take the case of our \$1.00 item with a demand rate of 100 units a year. Our EOQ assuming the same procurement and holding costs as before, is

$$Q = \sqrt{\frac{(2)(100)(100)}{(1)(.20)}} = 316 \text{ units}$$

The turnover rate for this item would be

$$\frac{100}{316/2} = .63$$

which means that we would expect our inventory to turn over once every $1/.63 = 1.6$ years. Note that

this is our optimum turnover rate for this item; that is, it is the turnover rate that reduces our variable operating costs to a minimum. So, if we are following rational inventory policies, the turnover rates we seek to achieve should be dictated by our EOQ's. Anything different from that would involve operating at a higher cost.

b. This raises another interesting point—the question of whether a standard inventory turnover rate should be set as a target for all NICP or for large classes of commodities. The answer is clearly no unless the items are homogeneous; a catalog with a high proportion of low dollar value demand items will have lower turnover rates than one with more high dollar value items, and rightly so. Turnover rates, if used as performance targets, must then be tailored to the characteristics of the catalog being managed.

c. Care must also be exercised in using inventory turnover rates as performance targets to distinguish what can be attained in the short versus the long run. A catalog with a high proportion of items in a long supply condition will experience low turnover rates until its on-hand inventory depletes through attrition to the desired level. Of course, one could decide to get rid of the long supply and try to operate at the long run optimal turnover rates immediately but, as will be seen in the next section, this is often not a desirable course of action.

5-37. Economic Retention Model

a. Even in a deterministic world it sometimes happens that stock on hand is greater than our anticipated short or midrange requirements, greater than the requirements objective. In the probabilistic world this often happens. It seems intuitively obvious, certainly after we have become aware of the costs involved in managing an inventory, that disposing of stock because it is excess in the short run might not be a wise thing to do. With a background in the elements of cost involved and how the cost elements are related to one another, it should be possible to consider the question of how much of the stock ought to be retained on economic grounds.

b. The basic model for making this decision is the following:

(1) Consider how much we would get for the stock if we were to dispose of it today. Call this value D .

(2) How much would this stock, whose value if it could be used now is V , be worth t years from now? Call this value V_t .

(3) How much would the total storage cost be for stock that is held for t years? Call this S_t . Then it is obvious that we would hold the stock for t years if

$$D \leq \frac{V_t}{(1+i)^t} - \sum_{j=1}^t \frac{S_j}{(1+i)^j} \quad (1)$$

or, in words, its disposal value is less than or equal to the stock's discounted value t years from now, less what it cost us to store it for that length of time. If we call the holding cost rate over t years $H(t)$, then the value of the holding cost in dollars will be $H(t) \cdot V$. From equation (4) of paragraph 8-27 we know that

$$H(t) \cdot V = V - \frac{V_t}{(1+i)^t} + \sum_{j=1}^t \frac{S_j}{(1+i)^j} \quad (2)$$

We can approximate V by the value of today's purchase cost C , and by transposing terms, express equation (2) as

$$\frac{V_t}{(1+i)^t} - \sum_{j=1}^t \frac{S_j}{(1+i)^j} = C(1-H(t)) \quad (3)$$

Substituting (3) back into (1), we get

$$D \leq C(1-H(t)) \quad (4)$$

or

$$H(t) \cdot C \leq C - D \quad (5)$$

This is the very simple equation that is used to find the economic retention level. Tables for $H(t)$ are computed using the appropriate values of the loss rate, 1, the deterioration rate, d , the storage cost rate, s , and the obsolescence rate θ . These tables are then used to find the largest value of t , which satisfies equation (5). This t is the longest period of time one is economically justified in holding stock before it is needed to satisfy the requirements objective.

c. There is an important economic interpretation to equation (5). It states that to determine the optimal t it is sufficient to find the point at which the increase in holding costs due to retaining an additional asset would be greater than the loss potential value due to its disposal. Holding costs in this context are measured until assets are reduced to the requirements objective; loss in potential value represents the difference between the unit cost of an item and its disposal price. Note that this is an excellent illustration of the concept of marginal costs and marginal revenue.

d. In actual practice, an adjustment to t equal to one-half the Procurement Lead Time is made and the computational procedure becomes—

(1) Let $D_f = D/C$.

(2) Find the largest t such that $H(t) \leq 1 - D_f$.

(3) Set Retention Years (RY) = $t - \frac{1}{2}$ PCLT.

The economic retention quantity would be RY multiplied by the expected demand rate for the item over that time horizon.

Section VII. PROBABILISTIC INVENTORY MODELS

5-38. DODI 4140.39 Model

a. The Department of Defense has published a regulation, DODI 4140.39, Procurement Cycles and Safety Levels of Supply for Secondary Items, which prescribes an objective function to be used in determining safety levels and order quantities different from that used in the MIT model. This regulation is currently being implemented, using much of the mathematics developed as part of the MIT model, adopted to the new objective function.

b. The performance constraint is now expressed in terms of "time weighted requisition short" or "average customer wait" instead of item availability. The following illustrates these terms:

Item	Example No. requisitions	Days wait (due to no stock)
1	20	0
1	10	1
2	10	0
2	5	3
2	1	10

c. The example says that 20 requisitions for item 1 were satisfied without delay, while on 10 others, there was a delay of 1 day per requisition because of lack of stock. Total requisitions received are 46 (20+10+10+5+1). Total time weighted requisition short is found by multiplying number of requisitions $\times$ number of days = wait per requisition.

$$\begin{aligned} \text{(Equation 9) Time Weighted Requisitions Short (TWRS)} &= 20 \times 0 + 10 \times 1 + 10 \times 0 + 5 \times 3 + 1 \times 10 = 35 \end{aligned}$$

d. Average days wait is the average number of days wait experienced by the inventory control point's customers because the inventory control point had no stock on hand when requisitions were received. Included in the average are requisitions for which there was no (zero) wait. The following is the mathematical relationship between time weighted requisition short and average days wait:

$$\begin{aligned} \text{(Equation 10) Average Days Wait} &= \text{Time Weighted Requisition Short} \\ &\text{divided by Total Requisitions Received.} \end{aligned}$$

Thus, in our example

$$\begin{aligned} \text{(Equation 11) Average Days Wait} &= 35 \div 46 \\ &= .76 \end{aligned}$$

Because of equation 10 any performance target given in terms of maximum time weighted requisitions short can easily be translated into a target maximum average days delay, and vice versa.

e. Under DODI 4140.39, the performance constraint is expressed for a catalog of items rather than

on an item by item basis as in the MIT model (equation 7). The objective function looks like this:

$$\text{(Equation 12) Minimize } \sum_i C_P F_P + C_H I_A$$

subject to the constraint that

$$\sum_i TWRS \leq \beta$$

where

$\sum_i$ = means take the sum over all items in the catalog.

β = is a single number giving the maximum permissible total sum of time weighted requisitions short for all items in the catalog.

C_H and C_P may vary from item to item.

f. Intuitively it is clear that minimizing operating costs (procurement and holding costs) on an item by item basis as in the MIT model is not much different than minimizing total operating costs over a catalog of items. But a catalog performance constraint is much different than a constraint which has to be met by each item's performance. It turns out, in fact, that to implement the DODI objective function, we can use the MIT model formulation, but with a different (availability target) for each item, these targets being dictated by the overall target (β); by the item's characteristics, and by the mathematics; and not by the decision maker, except insofar as he specifies β . The α for each item becomes almost an intermediate mathematical result used to satisfy β at least cost.

Define—

α_i = performance target for i^{th} NSN

λ = a number, to be discussed, related to β and dependent on it.

$\$D_i$ = dollar value of annual demand for i^{th} NSN

N_i = annual number of requisitions received for i^{th} item

H = holding cost rate (i.e., the holding cost C_H for one asset is computed by multiplying $H \times$ unit price. H is usually taken to be 20 percent).

Then, if we set α_i to

$$\text{(Equation 13) } \alpha_i = \frac{1}{1 + \frac{\$D_i H}{N_i \lambda}}$$

and use the correct value for λ , we can optimize in terms of the DODI objective function (12) by using the MIT model and computing SL and Q on an item by item basis just as if our objective function were really that of Equation 7. This remarkable result is based on a discovery made many years ago by Professor Herbert Galliher, then of MIT University.

g. λ is really a control knob. From equation 13 it is clear that by increasing λ , all the a_i are increased (if λ were 1 million all a_i would be approximately equal to 1, i.e., 100 percent). The higher the λ then, the higher the a_i , and the lower the time weighted requisitions short for each NSN and therefore in total for all NSN's. To implement DODI 4140.39 a special program is used to find that value of λ which will result in the performance constraint β being satisfied. Note that if λ is set too high, performance would be good, but we would be spending too much money, since safety levels for each item would be high in order to achieve the unnecessarily high a_i .

h. Equation 13 has a number of implications as depicted below.

VARIABLE	IMPACT ON TARGET PERFORMANCE
	(if variable is increased)
N	increase
\$D	decrease

The reader can verify the truth of the above by making up values for λ , H, \$D, N and plugging them into equation 13.

i. Now, for any given item it is true that N and \$D are likely to change together, and their effects may cancel. But in comparing the performance which will be achieved by different items under DODI 4140.39, the figure above indicates which item characteristics will dominate the performance differentials. Note that if unit price is high, the same demand will mean a higher \$D, hence lower availabilities.

j. While DOD may set a constraint (β) on time-weighted units short, or equivalently an average days wait, it is equally likely that at some stage in the budget and management process that available funds will be the constraining factor, not performance. In this case, λ is again used as a control knob, but it is set so that total dollars invested in safety levels is less than some value we will call γ . By constraining funds invested in safety level, total obligational authority can be constrained. The same program which can find a λ to match a β constraint on performance, can be used to find a λ to match a γ constraint in dollars. Again, λ determines the a_i and the a_i determine the safety levels calculated and therefore funds invested in safety levels as well as performance.

k. While λ is used as a control knob to satisfy a constraint, once the appropriate value of λ is found—call this λ^* —it is sometimes interpreted as the “implied cost” of a backorder. To understand the basis for this interpretation, suppose for a moment that the true cost of a backorder were known, and that it really was λ^* . Then a logical objective function would be

(Equation 14) Minimize (without constraints)

$$\sum_i C_P F_P + C_{HX} 1_A + \text{TWRS} \times \lambda^*$$

i.e., minimize total cost, without regard to constraints, where total cost is the sum of both operating costs and backorder cost, the last equal to number of time weighted requisitions short (TWRS) $\times$ cost per requisitions (λ^*).

l. It turns out that whether equation 14 is used, or the original objective function with the constraint which led to λ^* is used, the safety level and procurement quantities found for each item will be exactly the same! In this sense, then, the λ associated with a constraint is an implied cost, for it is what the backorder cost would have to be if we were to arrive at the same safety levels and procurement quantities (and a_i) we do arrive at based on a pure cost model without constraints imposed.

m. Equation 14 highlights the fact that under the DODI 4140.39 objective function, one requisition is treated as being equally important, or equally costly to backorder, as another, regardless of item, size of requisition, etc. This is intended as a useful simplification. Provision is made in the DODI to weight the λ used for different items by an item essentiality factor. However, there are no generally acceptable schemes for developing such factors and they therefore cannot be used at the present time. The Army, with DOD concurrence, does plan to use different values of λ for different weapon systems, so that items used on more critical systems can be given higher protection (high a_i).

5-39. Insurance Item Model

a. Insurance items are defined by these characteristics:

(1) No maintenance factor is computed. This means that the design and maintenance engineers through testing and previous experience come to the conclusion that this particular item will have no expected failures due to wearout.

(2) It is highly essential to end item performance.

(3) Typically, procurement lead times are long. Although insurance items have no expected failures due to wearout, spares are desired for emergencies. Even though the usual failure reasons do not apply to insurance items, accidents do occur. It also happens on occasion that a maintenance factor which is small but not zero is incorrectly estimated to be zero. Since the loss of one of these items will make the end item inoperative, it is very desirable to have a spare available before a demand occurs rather than to buy as needed, as we might for other low demand items.

b. The insurance item model is in a sense a special case of the MIT model. The objective function and

much of the mathematics is the same. The differences lie in the nature of the demand forecast used and the way in which standard deviation of demand is estimated, and the (archetypal) probability distribution selected as being most appropriate to insurance items. All these changes are based on the low demand rates for insurance items, and the difficulty in forecasting demand.

c. Demand forecasting for "normal" items is described in chapter 4, AR 710-1. Unique to insurance items is use of the "catalog" approach. Under this approach, the average demand experienced is computed for all items which have previously been classified as insurance, these items constituting the "catalog." If there were 1,000 insurance items, and if over a period of 2 years the sum of the demand for all these items were 2,000, then a catalog demand rate of 1 per year would be computed; i.e.,

$$1 = \left(\frac{2,000}{2} \right) \div 1000$$

d. For a new insurance item, the demand forecast is set equal to the catalog demand rate. Once demand history has accumulated for a particular insurance item, the demand forecast is computed as:

$$\text{(Equation 15) Forecast} = f \omega D_c + (1-f) \omega D_i$$

where

D_c = is the catalog demand rate

D_i = is the demand rate experienced for the particular item (possibly 0)

f = is a fraction between 0 and 1.

In other words, since demand history is particularly unreliable as a means of forecasting future demand for insurance items, the forecast is based on a weighted average of catalog rate and item historical rate f is the weight. Initially f is 1, so forecast equals catalog rate. As history accumulates, f is reduced so that the forecast is more influenced by what happened for the particular item, than by experience with insurance items in general. In general, the mathematics are such that the forecast will not be dominated by only one time surge in demand. If demand is consistently larger than would be expected for an insurance type item, the model contains criteria for reclassifying the item as not insurance, so that the demand forecast is no longer influenced by the catalog demand rate.

e. The Negative Binomial probability (archetypal) distribution is used for demand. The Negative Binomial is a member of the Compound Poisson family of archetypal distributions, and one way it arises is when demand is Poisson, but there is a probability distribution for possible values of the mean demand rate. The probability distribution in

this case is based on the observed differences in average demands for the various NSN's in the insurance item catalog.

5-40. Stockage Criteria Models

a. The cost differential model determines the minimum expected requisition rate (number of requisitions received per year) an item should have before it can be stocked. This is the decision variable. For example, if the minimum is 6, and an item is expected to have only 5 demands a year, it would be purchased on demand and direct shipped from manufacturer to the customer, rather than kept in stock at the wholesale level.

b. The objective function of the DOD stockage criteria model is similar to that of DODI 4140.39, in the form of equation 14. The idea is basically to minimize the sum of holding cost, procurement cost, and backorder cost. If the item is not stocked, there are no holding costs, but procurement costs are higher, because you have to buy more often (each time there is a demand). In addition, every time there is a demand, the customer's requisition must be backordered for a procurement lead time. Thus, as the expected requisition rate increases, the cost comparison begins to favor stocking an item versus buying on demand. The stockage criteria is the minimum requisition rate at which the cost comparison turns favorable to stockage.

c. To cost our backorders, a value of $\lambda/365$ per day on backorder is used. The λ is the λ found in using DODI 4140.39 so that the cost attributed to a backorder, at least implicitly, is consistent whether the decision, is how much to stock, or whether to stock at all.

d. The DOD model is probabilistic because it takes account of the fact that the true requisition rate for an item may be unequal to that forecasted. Since the model will be applied to slow moving items, and initially in a provisioning context only, this is a particular problem. The impact on the stockage criteria found is to make them higher than if a deterministic model were used; i.e., the DOD model leads to fewer items being stocked than a deterministic model would. The DOD model would not be used where there is a good alternative to either stockage or buying on demand—such as cannibalization. Also, insurance items could be stocked regardless of their low expected demand rate.

e. The Army is using a stockage criteria model at the retail level, but this model does not directly attempt to minimize costs. Rather it attempts to achieve specified demand accommodation levels with as few stocked items and as little turbulence as possible. Demand accommodation is defined as the percent of all demands received which are for items being

stocked. Turbulence relates to how often an item is placed on a stockage list, only to be removed when expected demands do not materialize.

f. A sophisticated economic stockage criteria model has been developed for retail level stockage, but while it minimizes cost, the criteria it produces are suspect in terms of their potential impact on operational readiness.

5-41. Stock Distribution Models

a. Three models will be discussed which were developed to aid in decision making in the area of stock control. Their current status varies from routine use, to authorized for use, to implementation deferred.

b. The MRQ (Maximum Release Quantity) model computes maximum release quantities for an NSN. If a requisition is received requesting more than the MRQ, only an amount equal to the MRQ is shipped. The idea is that a few large requisitions can cause demand variability much larger than is allowed for in the determination of the safety level. At the same time, at least some of these unusually large requisitions may be simple errors. The MRQ model determines what is a reasonable requisition quantity for an NSN based on its demand and price characteristics.

c. The "inter-depot transfer model" computes when an inter-depot transfer can be economically made by the national inventory control point, and how much to transfer. For example, suppose there are a group of items with significant demand activity expected both in the Pacific and in Europe. Such items would be stocked in both West Coast and East Coast depots. However, it sometimes happens that all the assets at a given time are at one depot, the West Coast depot for example. Possibly the European demand was new, or the assets represent retrograde from Vietnam. A transfer of some West Coast assets to the East Coast can save transportation money and give better customer support. Transportation money is saved because inter-depot transfer can often take advantage of bulk movement freight rates. In computing how much to transfer, the expected value of savings is maximized. Suppose the transfer is from West to East. The model computes and takes into account the probability that the transferred assets may actually have to be backshipped to satisfy West Coast customers as well as the probability that the transfer will save money. Back shipment can happen if demand forecasts are greatly in error. In other words, savings is a random variable because it depends on how the transferred assets are used, and this depends on future demand which is a random variable. The inter-depot transfer model does not apply to transfers made to consolidated storage.

d. The stock rationing model computes the size of a reserve for high priority requisitions. The concept is that if on-hand stocks are running low, it may be

better to backorder low priority requisitions in order to keep stock (the high priority reserve) available for high priority requisitions.

Define

B_L = (time weighted) low priority backorders

B_{1+} = (time weighted) high priority backorders

W = a weight, to be discussed

The objective function is

(Equation 16) Minimize the expected value of

$$Wx B_{1+} + B_L.$$

The weight W is a number greater than 1 which measures the relative importance of a higher priority versus a low priority requisition. Only crude estimates of W are available, but the solutions of the model are quite "robust" relative to the exact value; e.g., a solution can be based on a W of 3, and not be that bad even if W turns out to be 10.

e. The stock rationing model was first developed as an optimizing analytic model, but then simple "Heuristic" procedures for computing the reserve level were developed and shown by simulation to be almost as good as the more complex analytic solutions. In addition to W , the size of the reserve depends on the high priority demand rate, and length of the protection horizon. The protection horizon is the period until new stock is due in, at which time all demands can be satisfied. Since the reserve level depends on the protection horizon, it is changed dynamically as time passes.

5-42. Physical Inventory Scheduling Model

a. A physical inventory is a process for finding and correcting errors in the assets balance records of the inventory control point. Uncorrected errors lead to what are termed penalty costs; extra holding and backorder costs incurred by the supply system because of decisions based on incorrect asset information.

b. More frequent scheduling of inventories reduces errors and hence penalty costs, but the inventory process itself is costly. The scheduling model attempts to minimize the sum of the costs of taking inventories and the penalty costs. Alternatively, if the number of inventories is fixed, the model determines for which items an inventory will produce the biggest decrease in penalty cost on an expected value basis. It thus directs the inventory taking resources where they will do more good.

c. The estimates of penalty costs to be saved are based on—

(1) An empirical submodel which estimates the probability of having an error and the expected size,

if one exists, as a function of such item characteristics as number of demands received since the last inventory was taken.

(2) An analytic submodel which determines for any given asset record error, the expected value of the increase in holding and backorder costs due to this error.

d. The model is implemented by tables. These tables specify inventory frequencies and priorities as a function of an item's annual dollar value of de-

mand, quantity of demand, and frequency of demand. The frequencies are modified by special considerations. Pilferable, sensitive, and classified items are inventoried at least once a year. Items in long supply (items with assets greater than short to midrange requirements) are inventoried only once every 3 years. It turns out that even if items in long supply have asset record errors, these will not lead to penalty costs. This conclusion followed from a review of the dynamics of how error leads to penalty cost.

Section VIII. DEMAND FORECASTING

5-43. Introduction

a. Basic to most aspects of logistics management is the demand forecast. At the same time, many of the concepts and techniques used in forecasting other random variables have their analogues in demand forecasting, so that a discussion of this one topic has more general implications.

b. Ideally, we would like to base our demand forecast on a model of the demand process, using our knowledge of why demand is generated as part of the forecast technique. A successful application of this principle—the actuarial forecasting model—is discussed in paragraph 5-47. Failing this, we may at least identify one or more variables on which demand depends, such as projected aircraft flying hours, and utilize statistical methods to take advantage of this insight.

c. The simplest approach is to treat demand as a pure "time dependent" random variable. Demand is plotted against time; i.e., a time series is constructed as in Equations 17 through 25. Using statistical methods a forecast is made, and this forecast depends solely on the numbers plotted and the statistical method chosen.

d. In paragraph 5-44 various characterizations of demand as a time dependent process are discussed, and in paragraph 5-45 the most common statistical techniques for dealing with such a process are presented. Choice of technique is based in part on which characterization one accepts—is the demand cyclic, does it have a trend, etc.

e. Increasingly, choice of statistical technique is determined by simulation experiments. Real demand history is used; forecasts are made based on a part of this history, while another part is used to verify how good the forecast was. This is repeated using alternative forecasting techniques, and the technique which works best over a large sample of items is chosen and built into computer systems for logistics management.

5-44. Demand as a Time Dependent Process

a. *Classical Demand Patterns.* Demand patterns frequently discussed in the literature on forecasting techniques are—

(1) *Constant.* This pattern is illustrated in figure 5-14. Its characteristic is the tendency of demand to remain at a given level. Demand for any given month may deviate quite a bit from this constant level, but the deviation is random and does not change the basic pattern.

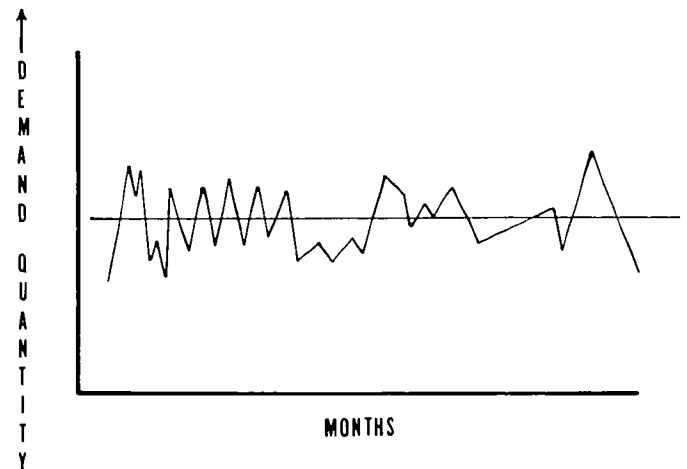


Figure 5-14. Constant demand pattern.

(2) *Step.* This pattern is a composite of two constant patterns. In this pattern, demand has a tendency to remain at a given level and then suddenly step up or down to a new level and remain at the level. The step represents an increase or decrease in the demand volume caused by a corresponding increase or decrease in activity that precipitates demand. An upward step pattern is illustrated in figure 5-15.

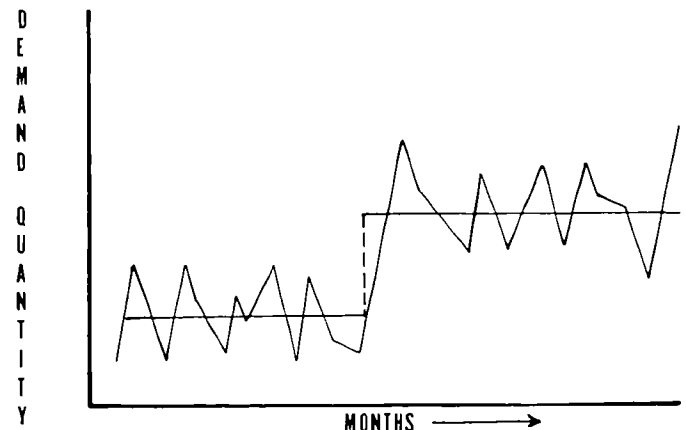


Figure 5-15. Demand pattern with a step.

(3) *Ramp (linear trend)*. Two ramp patterns are illustrated in figure 5-16. In this pattern, the tendency of demand is to continuously change its level in the same direction: i.e., up or down. As is illustrated in the figure, the incremental change may be very small or quite large, but it can be plotted by a straight diagonal line as in the figure, hence the name "linear trend."

(4) *Nonlinear trend*. Two nonlinear trends are illustrated in figure 5-17. The lower one is more complex than the upper and still more complex patterns are possible. Give a mathematician enough rope, and he can come up with a nonlinear trend to fit almost

any data. The question then becomes, "do we really have a trend at all?" "Trend" can be an ambiguous word, but one way to rephrase the question is: Is demand changing level as time passes in accordance with some predictable pattern?

(5) *Cyclical*. This pattern is characterized by a number of peaks and valleys that tend to occur at regular intervals as in figure 5-18. If the same pattern occurs from year to year, the pattern is called seasonal. Anti-freeze is an example of an item that would have a seasonal pattern.

(6) *Impulse*. Figure 5-19, shows a pattern with an impulse. A better known term for impulse is "out-

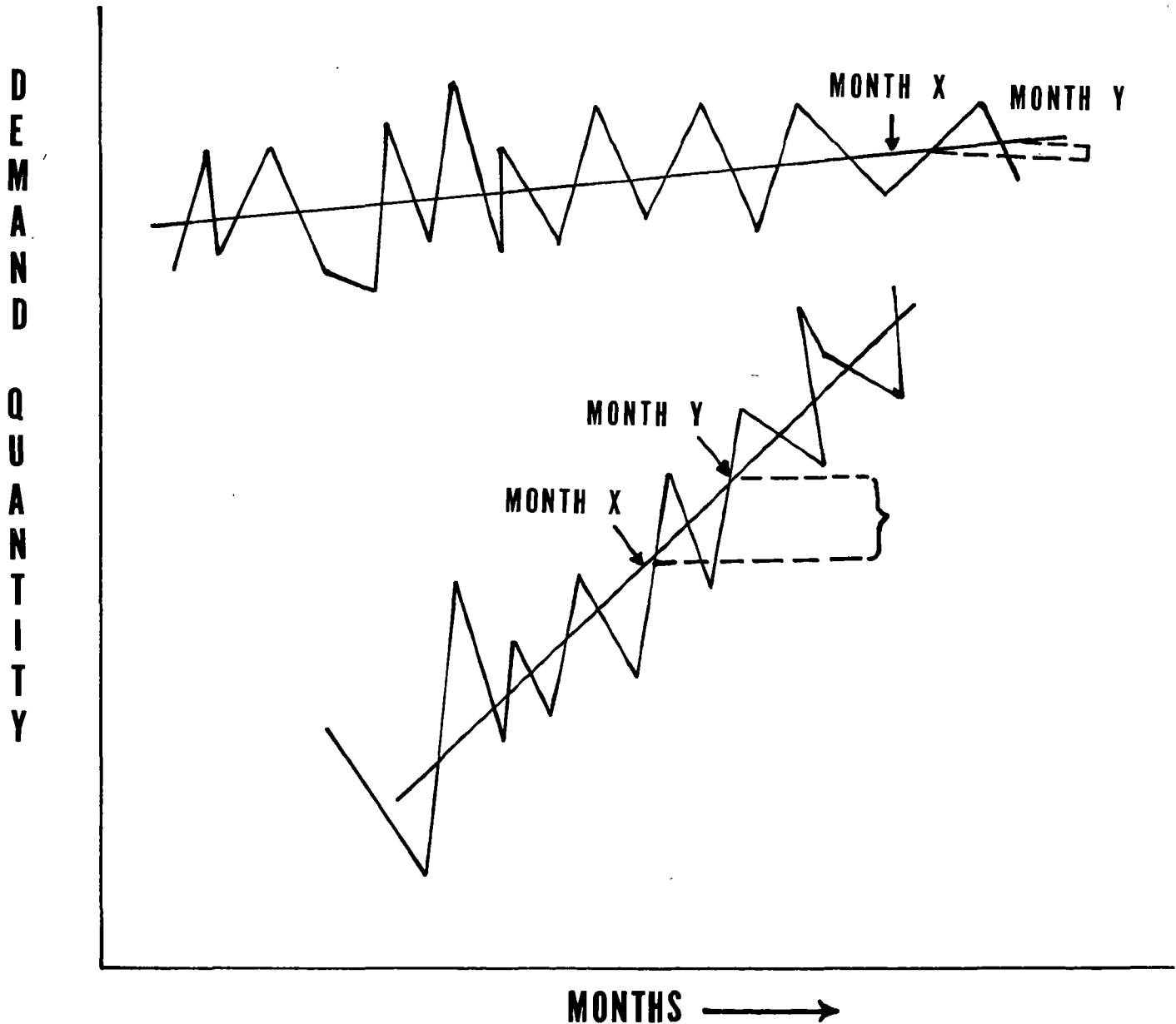


Figure 5-16. Ramp pattern (linear trend).

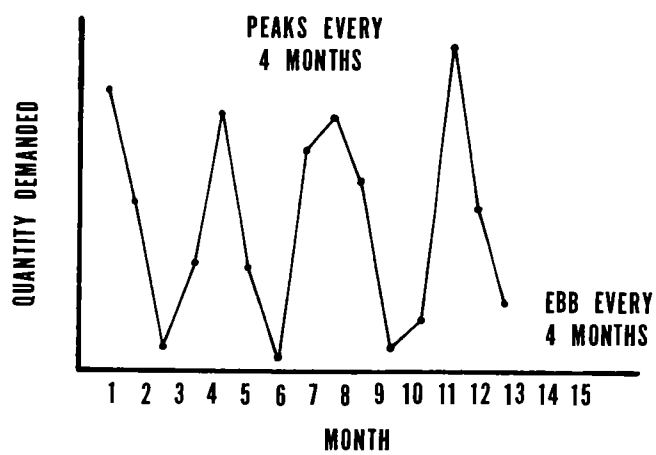
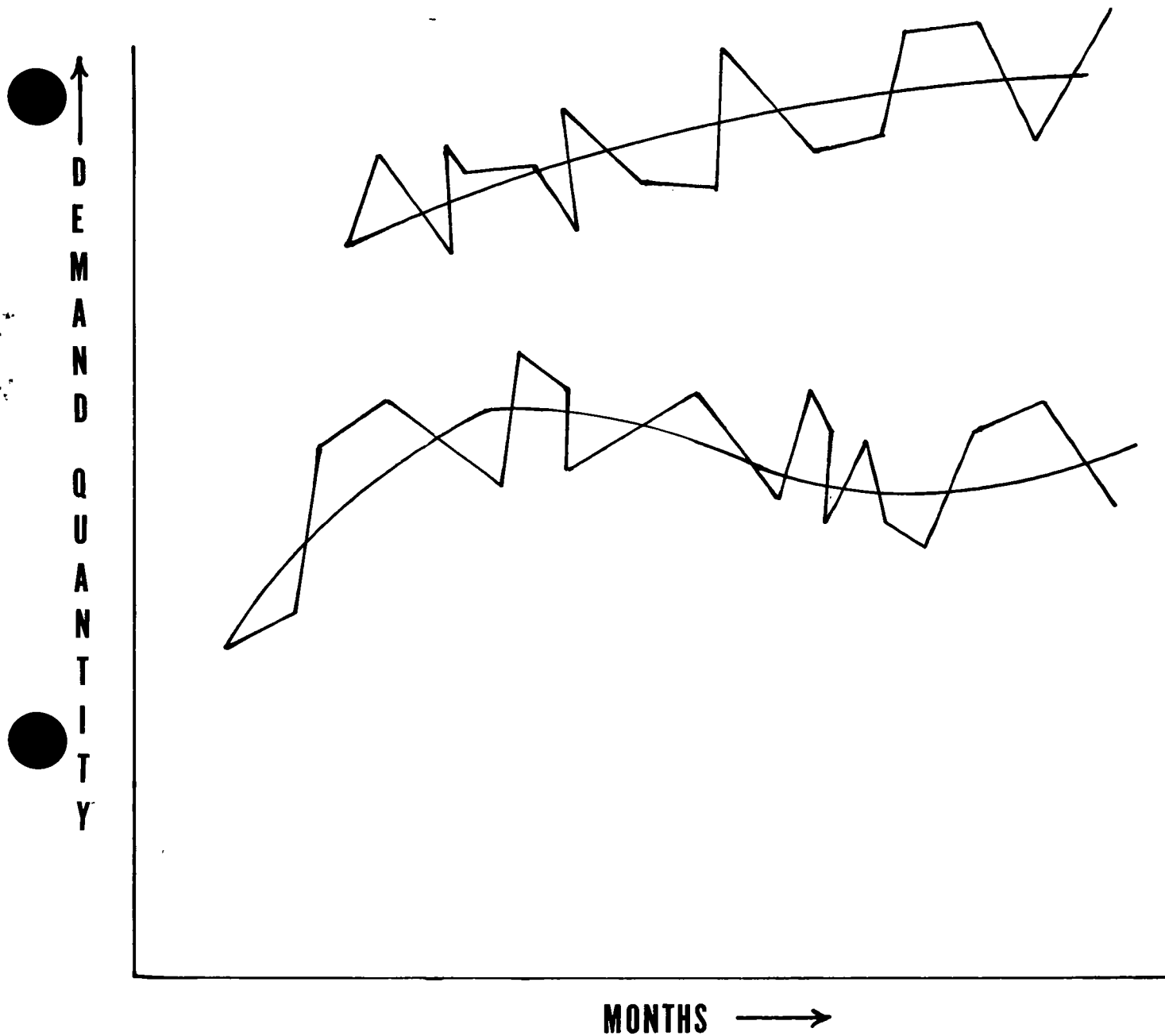


Figure 5-18. Cyclical pattern.

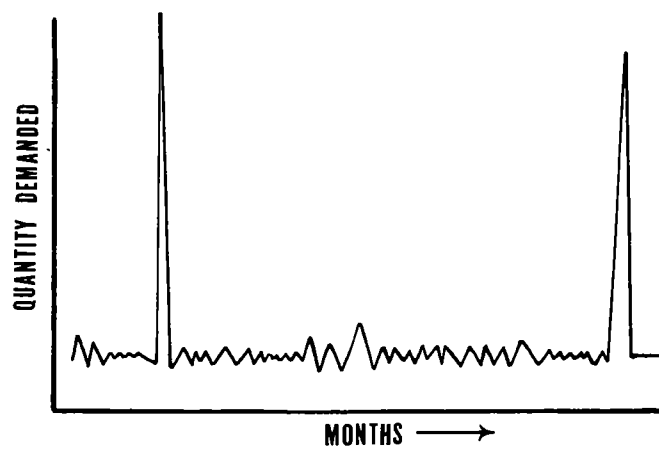


Figure 5-19. Impulse pattern.

lier." This pattern is characterized by a tendency of demand to remain at a constant level, usually very low, except for occasional periods in which demand is extremely large. This might be due to special maneuvers, special inspections, irregular ordering, or it might be due to a requisitioner's error.

b. Army Demand Patterns. Few repair parts in the Army have demand patterns as simple as those discussed above. Most of the patterns are composites of step, ramp, and impulse patterns that are further disguised by a large amount of noise; i.e., random fluctuations. One reason sometimes proposed for the amount of noise in repair part demand patterns is the multi-echelon nature of the supply system. According to this hypothesis, as you move upward in the supply system, toward echelons further removed from the user, demand variability increases, so that a reasonably smooth pattern at the user level translates into such patterns as those of figures 5-20, 5-21, and 5-22 at the wholesale level.

To appreciate the argument, suppose that there is a user with—

Requirements Objective = 2 Months of Supply
Average Monthly Use = 5 Units
Ordering Frequency = Once a Month

Now suppose he uses 10 units in a month. This may cause him to increase his estimate of average monthly use to 6 units. His requirements objective then increases from 10 units (2 months of supply x average monthly use of 5) to 12 units (2 x 6). He orders 10 units to cover his actual usage plus 2 units to cover the increase in his requirements objective. The next higher echelon sees a total demand of 12. In other words, when there was a 1-month change in usage (from 5 to 10) the change is magnified at the next echelon (from 5 to 12). Changes are magnified erroneously at each echelon. To date there has been no empirical proof that most wholesale level noise is caused by the type process just described, and in fact, some studies found just as much noise at lower echelons. This is a subject which will get more study.

5-45. Forecasting for Pure Time Dependent Processes

a. There are two basic approaches to forecasting pure time dependent process; "least squares" and "exponential smoothing." Many studies have been expended on the subject of which approach gives more accurate forecasts. The results of these studies indicate that there is little if any difference in accuracy. As a matter of fact, exponential smoothing, which was introduced after least squares, was not developed to make forecasts more accurate, but to achieve the same accuracy in a simpler manner. It is such secondary consideration as simplicity which may reasonably dictate the choice between approaches. Of

course, even the question of which approach is simpler is a subject of dispute.

b. There are various forms of least squares or exponential smoothing which can be used depending on which of the classic demand patterns you think best fits your data. We will discuss least squares and exponential smoothing for constant and ramp (linear trend) patterns, and then discuss some refinements to handle other patterns.

c. For a constant pattern, the least squares approach reduces to the familiar moving average.

Define

D_t , ACT = Actual demand in month t

n = number of months in base period

$\sum_{t=1}^n$ = summation over the most recent n months

F = forecasted monthly demand rate

Then, by moving averages

$$F = \frac{1}{n} \sum_{t=1}^n D_{u-t+1}$$

(Equation 17) $F = n \quad t = 1 \quad Du - t + 1$

For example, if $n = 12$, and total demand over the last 12 months was 96, the demand forecast would be $96/12$ or 8 per month. The demand equals the "average" historical demand over a base period which "moves" every month, so that it always includes the latest months. Of course, Moving averages can just as easily be defined in terms of quarters or some other period as in months.

d. Choice of a base period (should it be 6 months? 12 months?) may be limited by how much data can be kept. Otherwise, it is currently chosen by simulation experiments of the type described in the introduction to this chapter: moving averages using different base periods are simulated and the one which works best is chosen. The tradeoff is this: if demand really does have a constant pattern, the larger the base the better; e.g., 24-36 months; with a long base the moving average will focus in on the true mean and not be sensitive to noise. On the other hand, if a step or ramp may occur, a moving average with a long base will be slow to react to the change in general demand level, since it includes in the base period old data, many months in the past.

e. If demand is believed to definitely have a linear trend, the least square approach leads to a technique called "linear regression." In figure 5-23 a solid linear trend line is drawn through some data which does appear to have a linear trend. The dotted extension of the line represents what the demand forecast is (e.g., forecast for month 15 is 49, Linear regression forecasting is simply an algebraic technique equivalent to drawing a line through data and then extending it.

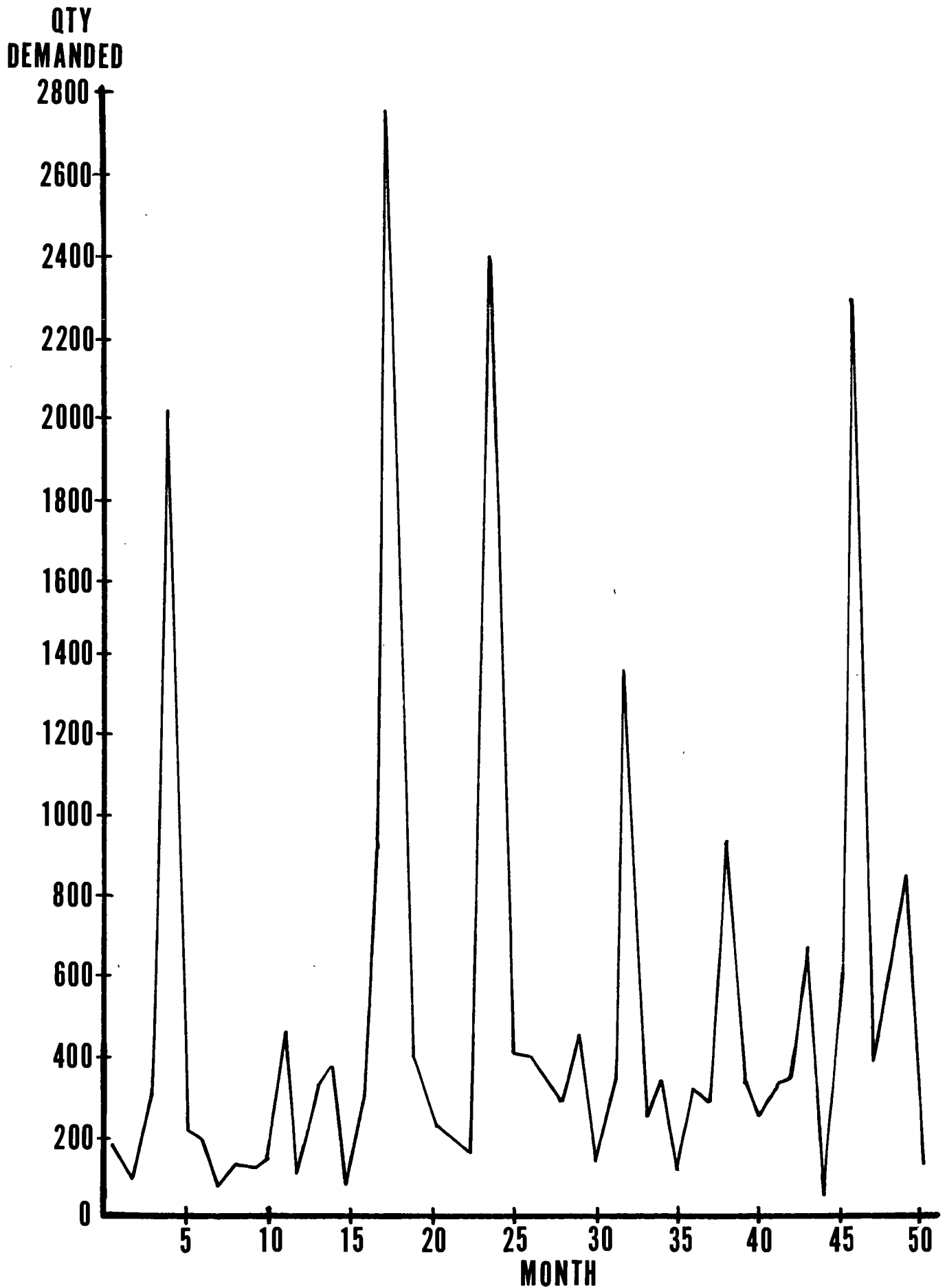


Figure 5-20. Actual demand pattern for automotive part.

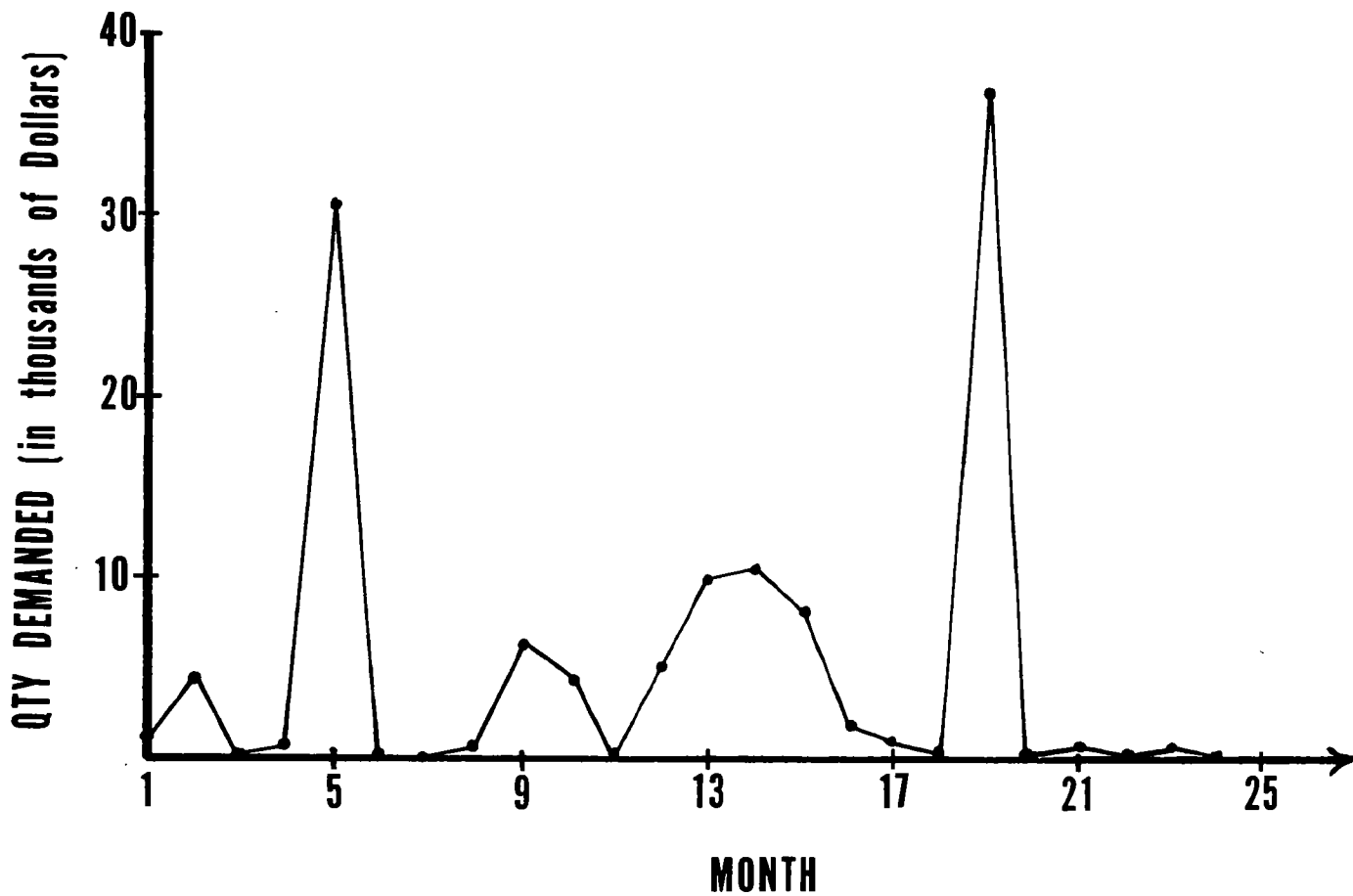


Figure 5-21. Actual demand for upper receiver (M-16 rifle).

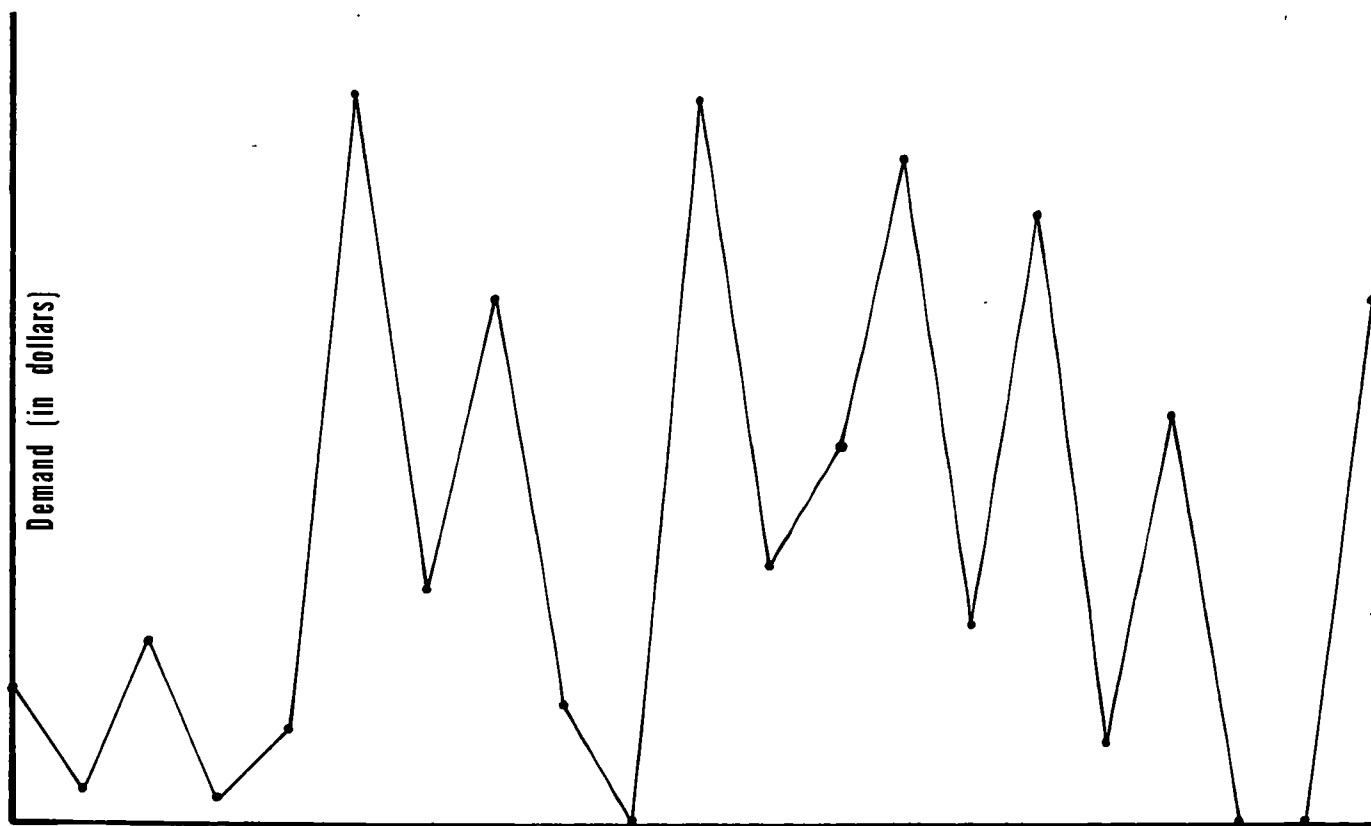


Figure 5-22. Actual demand for take-down pin (M-16 rifle).

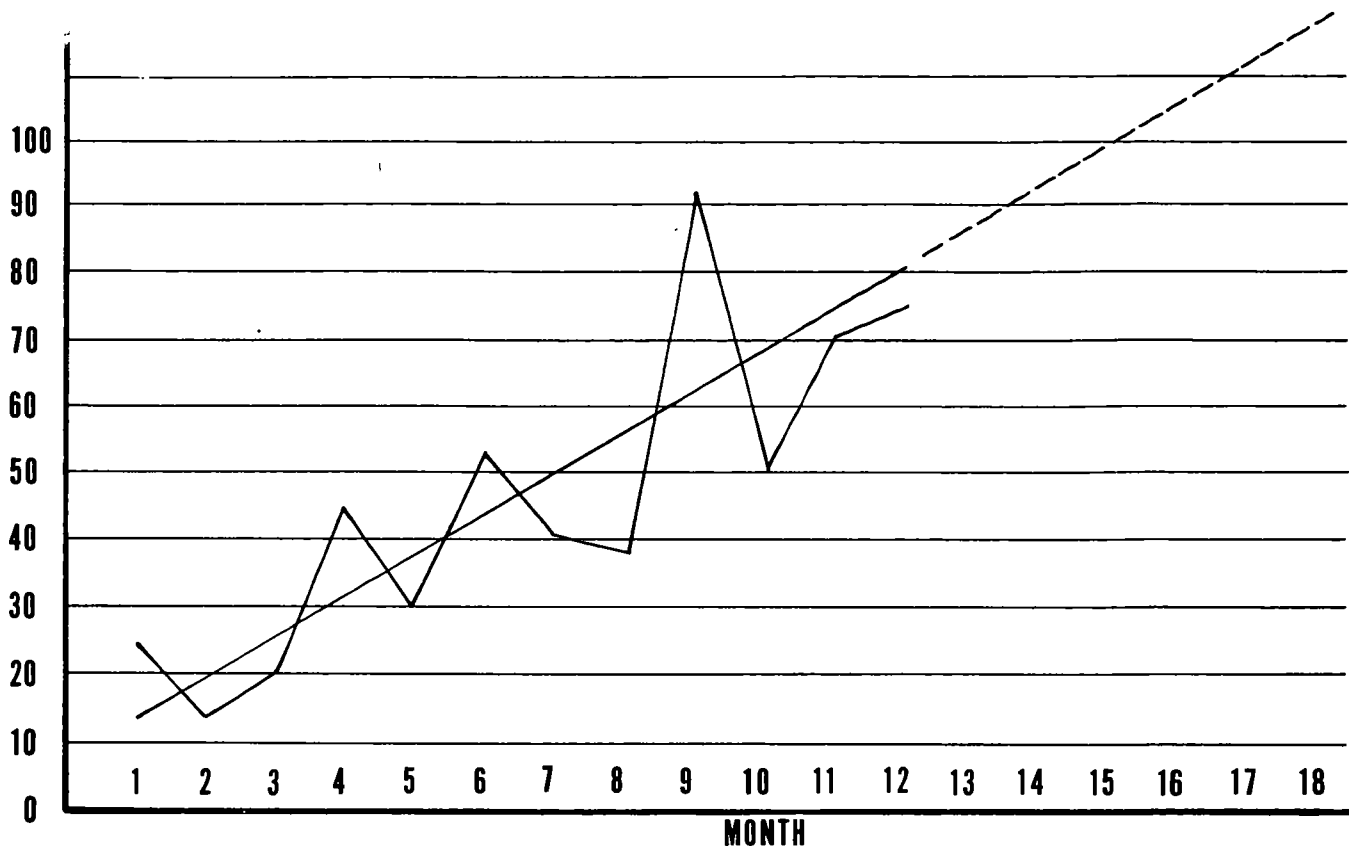


Figure 5-23. Fixed linear trend.

f. Algebraically, any line can be represented by the general equation

$$(Equation\ 18) \quad Y_t = a + bt$$

where in our case

Y_t = demand corresponding to the trend line
 t is the month (1, 2, 3, . . .)

a, b are "coefficients," or numbers which define what the line looks like

The line plotted in the figure has

$$\begin{aligned} a &= 4 \\ b &= 3 \end{aligned}$$

Thus, for month 5 ($t=5$) the point $4+3 \times 5$ or 19 falls on the line.

g. If two different people were to plot a line through the same data, they might not plot exactly the same line. In figure 5-24 possible lines through the same data are shown. Each line corresponds to a different (a, b) coefficient pair. Least square regression uses the "least squares" criteria which determines what a, b , will be:

(Equation 19) Find a, b which minimizes

$$\sum_{t=1}^n (Y_t - Y_{t-ACT})^2$$

where

$\sum_{t=1}^n$ — summation over the most recent n months

Y_{t-ACT} is actual demand in month t
 Y_t point on line for month t

By equation 18 $Y_t = a + bt$, hence the sum of equation 18 depends on the a, b chosen. What is being minimized is the sum of squares of the difference between actual data points, and the line through them; hence, "least squares." It turns out the solution of the minimization process is to set (Equation 20)

$$a = \frac{(\sum Y_t - ACT)(\sum t^2) - (\sum t)(\sum t Y_t - ACT)}{n(\sum t^2) - (\sum t)^2}$$

and

$$b = \frac{n(\sum t Y_t - ACT) - (\sum t)(\sum Y_t - ACT)}{n(\sum t^2) - (\sum t)^2}$$

h. A moving average forecast corresponds to a linear least squares regression in which b is set to 0, not calculated. Ideally, if there were truly no trend in data to which you tried to fit a linear regression line, you would find from equation 20 that b was 0. In fact, because of noise, you would calculate a b other than 0, and would erroneously project a trend.

i. Exponential Smoothing. Under (single) exponential smoothing, the forecast of monthly demand rate at the end of month n is

$$(Equation\ 21) \quad F_n = aD_{n-ACT} + (1-a) F_{n-1}$$

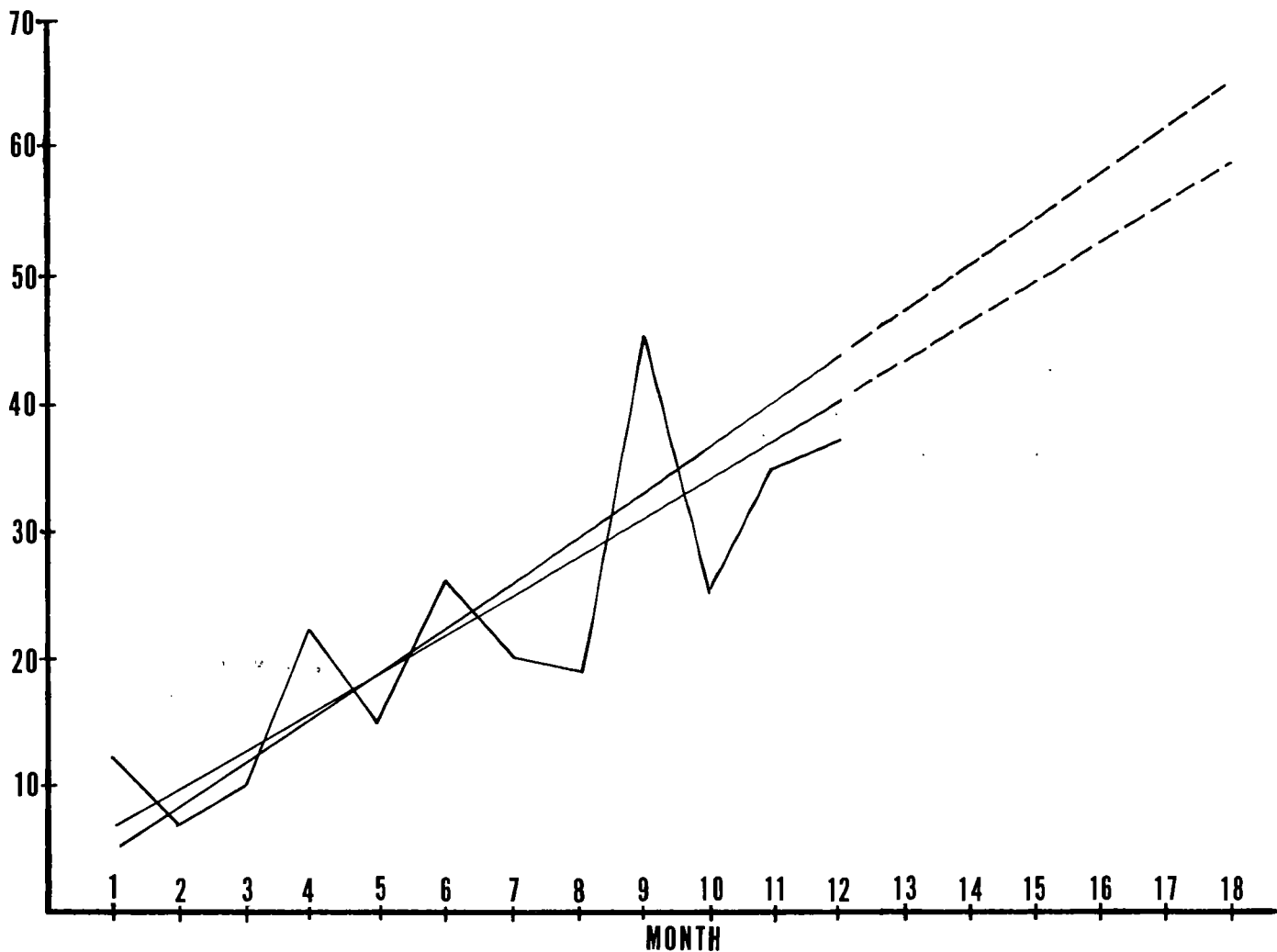


Figure 5-24. Alternative plot lines.

where

F_{n-1} —forecast which was made at the end of month $n-1$.

D_{n-ACT} —demand experienced in month n

α —a “smoothing constant,” some numbers between 0 and 1.

In other words, the new forecast is based on the old forecast, tempered by what happened last month. If we have—

$$\alpha \frac{F_{n-1}}{10} + \frac{D_{n-ACT}}{20}$$

then, the new forecast is $.8 \times 10 + .2 \times 20 = 12$

To start use of exponential smoothing you set F equal to your best estimate of the demand rate. Then

$$\text{(Equation 22)} \quad F_1 = \alpha D_{1-ACT} + (1-\alpha) \times F_0$$

$$\text{(Equation 23)} \quad F_2 = \alpha D_{2-ACT} + (1-\alpha) \times F_1$$

Substituting the expression for F given in equation 22 into the right hand side of equation 23, we get

$$\begin{aligned} \text{(Equation 24)} \quad F_2 &= \alpha \times D_{2-ACT} + (1-\alpha) \times \\ &\quad [\alpha \times D_{1-ACT} + (1-\alpha) \times F_0] \\ &= \alpha \times D_{2-ACT} + \alpha(1-\alpha) \times \\ &\quad D_{1-ACT} + (1-\alpha)^2 \times F_0 \end{aligned}$$

In other words, although, F_2 is not explicitly based on D_{1-ACT} , its value is dependent indirectly on what D_{1-ACT} is, as derived in equation 24.

j . In general, although exponential smoothing explicitly uses very little data—and this is one of its advantages—it can be shown that repeated use of exponential smoothing is equal to setting

$$\text{(Equation 25)} \quad F^n = \sum_{t=1}^n \frac{D_{t-ACT}(1-\alpha)^{n-t}}{\alpha(1-\alpha)^n} + \alpha(1-\alpha)^n F_0$$

In words, F_n is equal to a weighted average of past observations, where the oldest gets least weight and the newest the most weight. For $\alpha = .2$ and $n = 12$, the most recent month ($t = n$) gets a weight of

$$\alpha \times (1-\alpha)^{n-t} = \alpha \times (1-\alpha)^0 = \alpha = .2$$

The oldest ($t = 1$) sets a weight of

$$\alpha \times (1-\alpha)^{n-1} = \alpha \times (1-\alpha)^0 = \alpha^{n-1} = .2 \times (.8)^{11} = .2 \times .086 = .0172$$

k . What value of α to use in exponential smoothing is analogous to what length base period to use for a moving average? Higher values of α give more weight to the most recent observations, hence permit better

adaptation to changes in demand levels, but more sensitivity to noise. It is sometimes recommended that a low value of α be used, and then if there is reason to believe a change in demand level is occurring, switch to higher values of α . Statistical schemes have been devised for automatically changing α , or the base period length in moving average forecasting, but recent experimentation by the Air Force showed negative results for any scheme tested.

l. Exponential smoothing of the kind described (equation 21), is sometimes referred to as "single" exponential smoothing. Single exponential smoothing does no better in forecasting if there is an underlying linear trend than does moving average. However, there is "double" exponential smoothing which is comparable to linear regression. In fact, just as there is non-linear or polynomial regression, there is triple exponential smoothing, etc. Details will not be discussed here.

m. There are quite sophisticated computer programs around, used by such organizations as the Department of Commerce, to develop seasonal correction factors. Suppose, based on historical analysis, we believe auto sales tend to be 10 percent higher in March than for the yearly average. Then we may multiply all our March sales figures by 100/110 to get adjusted sales before inputting them to our statistical forecasting procedures. This prevents treating a seasonal increase as indications of a new trend. Then when we have determined in average monthly demand rate, we multiply by 110/100 to get our estimate for March.

n. Studies have not found seasonality in most Army parts. Moreover, if a 12- or 24-month moving average is used, the base period always has all seasons equally represented, so there is little need for seasonally adjusted input for forecasting. (This is not true of exponential smoothing which weights each month in the base period differently.) It is likely that in the future some use will be made of seasonal indices—for higher dollar value, seasonally demanded items where the procurement cycle time is only a few months, so what they buy should depend on the season.

o. The MRQ model is designed to filter out outliers to the extent that they exceed reasonable limits on order sizes.

5-46. Demand as a Program Dependent Process

a. Program data refers to usage data such as aircraft flying hours, or tank miles traveled; to density data such as number of fielded trucks; to workload data (such as number of overhauls scheduled). In using program data, we are usually relating future demand to future program. If our estimates of future program are poor, there is little value in doing this because we are trading in one problem, forecasting demand; for another problem, forecasting program. In

fact, however, most program data are at least to some extent controllable variables rather than random variables; i.e., number of fielded trucks or flying hours flown are DA/DOD planning variables, with effort being made to live up to plan.

b. The basic program—demand relationship is—

$$\text{(Equation 26)} \quad D_t = a + b \times P_t$$

where

D_t — demand in period (e.g. month) t

P_t — program value for period t

a, b — are coefficients to be found

c. The program factor approach is the predominant method by which the Army has implemented use of program data in the past. It may be thought of as a special case of equation 30 where a is set to 0, so

$$\text{(Equation 27)} \quad D_t = bP_t$$

However, the method described in Section IV is not exactly equivalent to the least squares approach, but is simpler.

d. Lagged variable models are currently being considered. The simplest such model is

$$\text{(Equation 28)} \quad D_t = a + bP_t + cP_{t-1}$$

In other words, equation 28 states that demand in any period depends on what the program was the period before (in period $t-1$). There is a lag projected between changes in program, and their impact on repair parts consumption. Equation 28 can be generalized:

$$\begin{aligned} \text{(Equation 29)} \quad D_t = & a + bP_t + cP_{t-1} \\ & + dP_{t-2} \\ & + eP_{t-3} \end{aligned}$$

The coefficients $a, b, c, d, e \dots$ can be determined by at least squares regression type approach. Alternatively, a relationship can be hypothesized between the coefficients, leading to an equation such as

$$\begin{aligned} \text{(Equation 30)} \quad D_t = & a + bP_t + (b\alpha) \\ & \times P_{t-1} + (b\alpha^2) \\ & \times P_{t-2} \end{aligned}$$

" α " is a number between 0 and 1 showing the "decay" in impact of program on future demand as time passes. For example, if $b=1$, $\alpha=.1$, and the program is number of flying hours, the implication would be that each 1,000 flying hours flown leads an average to:

(i) a demand for $1,000 \times 1$ part in the current period

(ii) a demand of $1,000 \times 1 \times .1$ parts in the next period

(iii) a demand of $1,000 \times 1 \times .01$ parts in the period after that, etc.

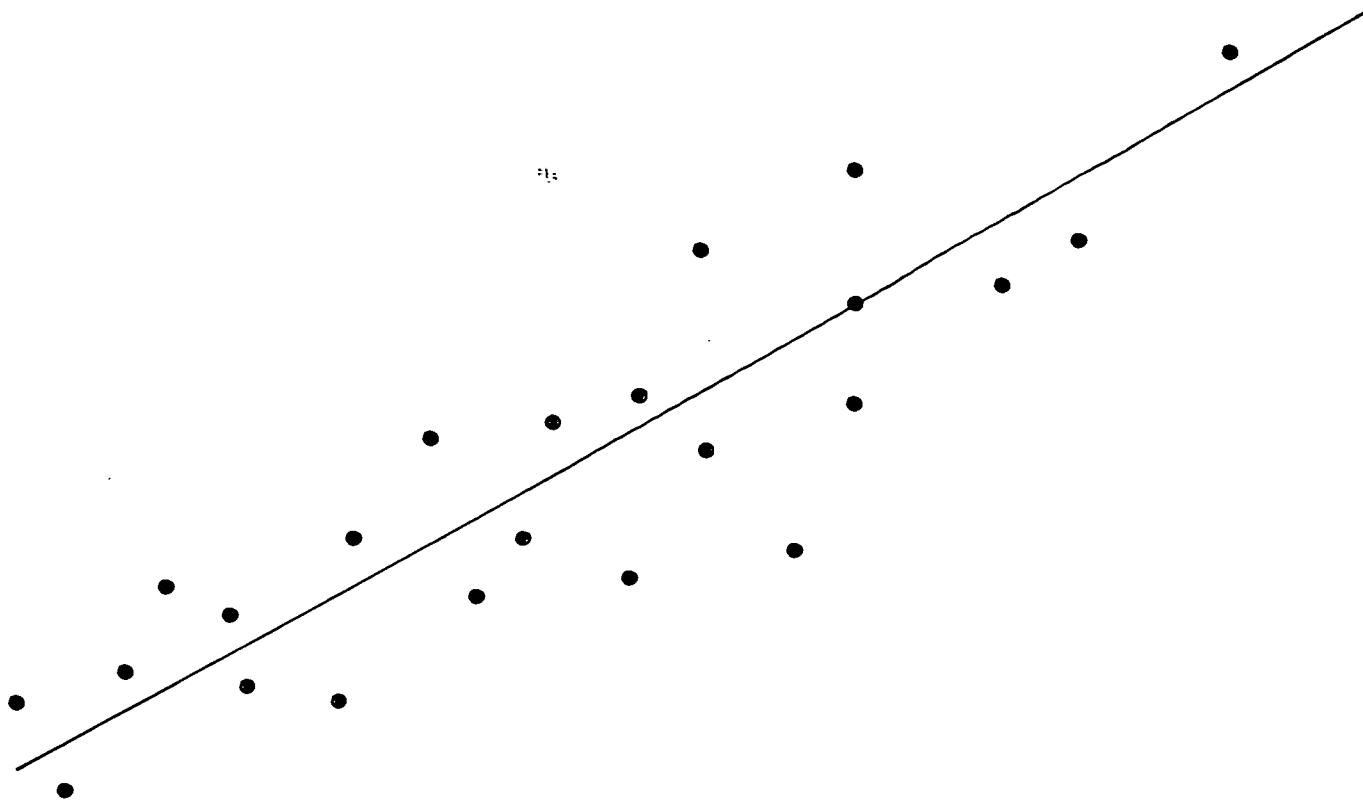


Figure 5-25. Demand versus program.

e. It often happens that one part has several applications. For example, a spark plug may be used on several kinds of trucks. Demand data do not indicate which part of the demand was due to each truck, so we cannot make separate forecasts for each truck type. One approach is to set up an equation such as

$$\text{(Equation 31) } D_t = a + b x P_{1t} + c x P_{2t} + \dots$$

where P_{1t} refers to fielded density of one kind of truck and P_{2t} to density of another kind of truck. Alternatively, the approach currently taken is to take a weighted sum of densities (or flying hours or other program data) setting

$$\text{(Equation 32) } P_t = W_1 P_{1t} + W_2 P_{2t} + \dots$$

where

$W_1, W_2 \dots$ are weights to be explained

P_t is the single derived number used to represent program either in calculating program factors or in such equations as 27 and 29.

f. There are three main approaches to getting the weights. First, they may all be set to 1, so densities or flying hours, or whatever, are summed equally regardless of weapon system. Second, the weights

may be based on quantity per system, so if 6 spark plugs are used on one truck and 8 on another (a ratio of 4/3), the density of the first truck type is given a weight of 1, density of the second is given a weight of 4/3. The third approach to deriving weights for part consumption of different weapon systems is to use engineering estimates. For every weapon system on which a part is used, there is an engineering estimate of use. These estimates are developed prior to provisioning, and in fact serve as the only basis for demand forecasting before demand experience accumulates. Now suppose the engineering estimated rates of usage for a part in truck type 1 are 10 per 100 trucks per year and on truck type 2, 5 per 100 trucks per year. This suggests a weight of 2 (i.e., 10/5) for truck type 1, and a weight of 1 for truck type 2. Even though the values furnished by the engineers (10, 5) are usually not used directly once a forecast can be based on actual demand experience, they can still have some merit as relative weights of consumption on different type end items.

g. It is quite possible that the program/demand relationship will depend on geographical area or mission (e.g., combat versus noncombat versus Reserve Forces). The current method for dealing with this is to make separate forecasts by area or by customer (i.e., Reserve Forces might constitute one Customer).

h. If the correct program/demand relationship works like equation 29 for example, it is easy to understand why the program factor approach might do more harm than good in some cases by overstating the short term effects of program changes. With more complex forecasting equations, there is increasing danger that noise can cause poor estimates of the equation coefficients and lead to bad forecasts. There is always the problem of correctly projecting program data. For all these reasons, use of program/demand relationship must be done with care. And indeed a number of empirical studies indicate that the relationships may be quite difficult to find.

5-47. Actuarial Forecasting

a. For some types of items, particularly those that are very expensive, we are willing to venture into even more expensive and sophisticated methods of forecasting because of the large benefits that can be obtained from increased forecasting precision. Aircraft engines are a good example of such an item. The reduction in investment for spare aircraft engines that can be obtained even for relatively modest improvement in the forecasts of failure rates justifies the use of more exotic procedures such as the actuarial procedure now to be described.

b. Suppose we are asked to estimate the mean-time-to-failure for a given type of aircraft engine by observing the flight hours logged on each engine that has failed. Would we obtain an accurate estimate by averaging these observed times? The answer might well be no, because in doing so, we have ignored the engines that are still in service and that have not yet failed. This is a mistake that is often made in the early years of an aircraft's deployment when the times to failure of those engines that have failed are used to estimate the mean-time-to-failure, leading frequently to overestimates of the number of failures to be expected during future time periods.

c. The actuarial method, which is analogous to that used by insurance companies, can be used to advantage in forecasting the expected number of failures of items whose failure process is age dependent. A failure process is said to be age dependent if the probability of surviving from one age to the next

depends on the present age. The probability of a 20-year old man living to age 21 is obviously much different from the probability of an 80-year old man living to age 81. So, in forecasting how many deaths to expect next year, the insurance companies have to know not only the probability of an individual's survival from one age to the next but also how many persons there presently are in each age group.

d. The same principle can be used in forecasting the expected number of failures of aircraft engines during a given period. From engineering analysis or from study of failure data, we can estimate the probability that a brand new engine will survive without failure in its first 50 hours of use, the probability that an engine that has logged 50 hours of use will survive without failure until 100 hours of use, etc. Then if we know the age of each installed engine and the number of hours expected to be flown by the aircraft during the forecast period, the expected number of failures during that period can be readily calculated. The calculation itself is somewhat tedious for each failure results in the replacement of the aged engine with a new one so that the distribution of ages of the installed engine with a new one so that the distribution of ages of the installed engines is constantly changing. The calculation is something like a simulation in that the aircraft are "flown," hours of use are logged on the installed engines, a certain fraction of the engines "die" and we "fly" from one age interval to the next and are replaced by new engines, and so on until we reach the end of the forecast horizon.

e. The actuarial procedure can be adapted to handle a variety of special situations encountered in military logistics just as it is applied to all sorts of special insurance situations. One can, for example, forecast separately the expected removals requiring minor repair as distinguished from those requiring major overhaul, or one can adjust survival probabilities to maintenance policies that are changing over time. The procedure has been in use in the U.S. Air Force for engine management for many years and has been successfully applied in the Army and Navy in the management of certain of their most expensive aircraft engines.

Section IX. MOBILIZATION REQUIREMENTS

5-48. Introduction

The basic objective of the Department of Defense is to be prepared to support national policies and to successfully defend the Nation. A primary element of military readiness is the sound and careful establishment and management of adequate war reserves. Accordingly, the Army has established and maintains a positive and continuing War Reserve Materiel Program.

5-49. Computation of Mobilization Requirements

a. War reserve quantities are computed in accordance with the levels contained in AR 11-11, planned unit deployment schedules to a combat area, the requirements set forth in applicable contingency or mobilization plans, and special guidance and policy provided by HQ DA.

b. The War Reserve Materiel Requirement

(WRMR) is that portion of the war reserve materiel (WRM) required to be on hand on D-Day. This represents the stocks of equipment that must be acquired in peacetime to meet the increased military consumption which would result from an outbreak of war. These stocks are intended to sustain combat operations until resupply to the combat area can be established. The War Reserve Materiel Requirement can be further categorized as follows:

(1) *Theater war reserves.*

(a) Theater war reserves and those quantities of combat essential equipment (war reserve stockage list (WARSL) SB 700-40) which are authorized each theater in days of supply as prescribed in AR 11-11 to support post D-day combat consumption until resupply from CONUS can be established. For tactical, logistical, and economical reasons, the quantity of equipment in the theater war reserve stocks should be maintained at a minimum level consistent with the combat mission and CONUS resupply capability.

(b) Approved DA operational project stocks which are stored by overseas commands, DARCOM, and FORSCOM. This includes pre-positioned materiel configured to unit sets (POMCUS) to reequip specific TOE type units upon initial deployment. POMCUS will be based on approved pre-positioning requirements. This materiel will be authorized, and accounted for as an approved DA operational project additional to the theater war reserves discussed above.

(2) *CONUS war reserves.* These include that portion of the War Reserve Materiel Requirement held in CONUS depots. CONUS war reserves were categorized and explained in Chapter 7.

5-50. Composition of the War Reserve Stockage List (WARSL)

a. The WARSL is a listing of principal and secondary end items, POL, operational rations, clothing and expendable items authorized for stockage in war reserves for use by U.S. Forces. Although not listed, functional components, repair parts, etc., necessary for mobilization support of WARSL end items, are also authorized for stockage.

b. The following criteria are used for the selection of items for the WARSL:

(1) Items essential for combat forces.

(2) Items essential for the operational effectiveness of combat support and combat service support forces in support of combat forces.

(3) Items the lack of which would render inoperative or seriously impair the operational effectiveness of essential equipment or weapon systems.

(4) Items essential for the sudden expansion of forces, including the callup of Reserve component forces.

(5) Items which are specially managed for security classification reasons, to include items controlled by the Department of Energy (DOE) or National Security Agency.

(6) Items required for survival and protection of personnel.

(7) Items designated as operational rations.

(8) Items necessary for the maintenance of personal hygiene or health.

c. Criteria for selection of war reserve materiel is contained in AR 710-1.

(1) Items contained in the WARSL will be recommended by MACOM's as essential for operational effectiveness of combat, combat support, and/or combat service support forces. All Reportable Item Control Code 1 (RICC 1) items (contained in SB 700-20), selection of strategic communications items and associated communications security materiel to be maintained in the war reserve are based on recommendations made by the Commander, US Army Communications Command, subject to approval by HQDA. Selection of tactical communication security materiel to be maintained in war reserve is based on recommendations made by the Commander, USACC, in coordination with the Commander, FORSCOM, and oversea commander subject to HQDA approval. The Surgeon General reviews and approves medical items contained in all war reserves. HQ DARCOM performs the necessary review and editing of the WARSL and submits the WARSL to HQDA for approval.

(2) Temporary use of war reserves to include operational project stocks is as follows: Release of fixed and COMSEC telecommunications equipment will be made only by the Deputy Chief of Staff for Logistics. Requests should indicate the date items will be replaced. Principal items contained in purpose codes C, D, E, S, and T (AR 725-50) will not be issued permanently or temporarily for peacetime use without prior approval of DCSLOG. Requests for temporary use should indicate the date the item is expected to be replaced. The FORSCOM and oversea commanders may use Class II secondary items, Class III packaged POL, Class IV and Class VIII materiel, and Class IX repair parts from theater PW RMS, less pre-positioned materiel configured to unit sets, in their respective commands to meet peacetime operational requirements provided that the stocks can be replaced within sufficient time to meet the requirement for which the stocks were intended, and in no case longer than 90 days from the date of withdrawal for FORSCOM, and no longer than 120 days from date of withdrawal for oversea commanders. However, oversea commanders may use such assets, without assurance of timely replacement, for high priority units whose equipment is deadlined for

parts. Replacement action will be initiated immediately on all such withdrawals. The Commander, DARCOM, PWRMS of secondary items to fill peacetime operational requirements provided peacetime funds are available to purchase an equal dollar amount of replacement stocks, and can be obligated for that purpose, or for which peacetime stocks due in are sufficient to make replacement.

(3) War reserve stocks may be used for any Army or international logistics urgent peacetime requirement. CONUS war reserve stock may be used for peacetime MAP emergencies only. Normally, such issues will be limited to requisitions with issue priority designators 01 through 08 (AR 725-50). Extension to lower issue priority designators to improve supply to troops engaged in combat operations short of general war may be temporarily authorized by DCSLOG.

(4) War reserve stocks are not segregated from peacetime operating stocks but are combined with them to achieve rotation, as a safeguard against deterioration. However, war reserve materiel is accounted for separately from peacetime stocks in accordance with AR 725-50.

d. Industrial preparedness:

(1) The Army selects items for war reserves which will sustain, in wartime, all necessary combat and combat support operations and the expanded logistics system required to maintain the operations. Not all required quantities of selected items may be acquired or stocked due to economic constraints beyond control of HQ DA. Awareness of the funding situation should not, however, inhibit the selection of items vital to the approved wartime missions. It is imperative that all commands insure that only those items vital to the initial support of the wartime mission are selected as war reserve items. Only urgent military considerations may serve as justification for making exceptions to the established criteria.

(2) Procurement of reserve stocks is closely related to the capacity of the production base. An optimum balance must be achieved for each primary item or item group between end item stocks on hand and the readiness status of the production base. The

Industrial Preparedness Planning (IPP) Program deals primarily with the peacetime development and maintenance of a mobilization base which can be rapidly activated or expanded to support the mobilization materiel requirement of approved US Forces. Facilities in the production base must be ready for expeditious reactivation or expansion after M-Day to permit maximum acceleration of output to the required level.

(3) The Army supports the basic principle that free competitive enterprise should be fostered by the Government. Planning with private industry under the IPP Program will be accomplished as necessary to insure a continuous capability by designated suppliers to meet the mobilization materiel requirements they have agreed to produce. Private industry is encouraged to provide the facilities required to meet both peacetime and mobilization production schedules. Industrial preparedness planning includes planning agreements with industry for both procurement and depot maintenance. Preferences in selection of planned mobilization suppliers will be given to firms willing to supply such facilities.

(4) Shortages of mobilization stocks may be balanced by management through the drawdown of other mobilization items which are in a very favorable stock position. As stocks in long supply are issued to requisitioners, they are paid for from funds which the requisitioner has available. Funds retrieved by this method may then be used for procurement of the items whose stocks are below desired levels.

(5) Provision is made by the Production Base Support Program for the continuing establishment and maintenance of Government-owned capacity to meet peacetime and mobilization production requirements for materiel not available from, or not considered appropriate for production by, commercial sources. The capability is designed so that mobilization production schedules computed on the basis of planning guidance from the Secretary of Defense may be met.

(6) Provision is made for developing manufacturing data essential to production of mobilization items not currently being procured.

Section X. SECURITY ASSISTANCE

5-51. General

a. Within the Department of Defense and the Department of the Army, the provision of logistics support to friendly foreign nations under the Foreign Assistance Act of 1961 and the Foreign Military Sales Act of 1968 is called Security Assistance (SA) support. A variety of means are employed in planning, developing, and administering SA support to eligible countries. Current legislation continues to grant to

the President the general authority for providing military assistance. It authorized him to acquire defense articles and services from any source and to provide this support by grant, loan, exchange, sale, lease, or any other means. Whatever the method, there is an impact on the Army logistics systems. All pending commitments must be evaluated to be sure that they have been carefully coordinated with US requirements and can be met within the proposed time.

b. In matters of SA, the DA, like other military departments, participates in the development, negotiation, and execution of agreements with foreign governments. The degree of direct participation of the various activities of the Army depends upon the particular nature and circumstances of the program being developed.

5-52. Responsibilities

a. The Director of Security Assistance, Office, Deputy Chief of Staff for Logistics, Department of the Army provides policy direction and monitors IL materiel and supply activities within the Army. The DARCOM, The Surgeon General, the Chief of Engineers, and The Adjutant General are responsible for achieving SA objectives and fulfilling specific logistics requirements established by Headquarters, Department of the Army, and Office of the Secretary of Defense.

b. The US Army Security Assistance Center (USASAC) is the operating activity, under the Directorate of Security Assistance, DARCOM, responsible for all operational matters regarding the

implementation of SA programs. The USASAC provides control for all requisitions prepared in support of the SA customer. Detailed procedures are contained in the AR 795-series. The dominant role of the center in the preparation and submission of requisitions to the CONUS supply agencies facilitates the integration of the respective SA program requirements with those of US Forces. Thus, through this activity, the execution of the programs for the support of friendly foreign forces is centrally monitored and the necessary elements of supply and financial data may be accumulated and prepared for analysis and reviewed by the responsible division of the DARCOM Directorate for USASAC, Headquarters, Department of the Army; and the Office of the Assistant Secretary of Defense (I&L).

c. Within each of the DARCOM materiel readiness commands, as well as other Army activities, there is an element charged with specific international logistics responsibilities. This element plans, administers, and coordinates SA activities within the respective materiel readiness command or national inventory control point.

CHAPTER 6

ACQUISITION DIRECTIONS

Section I. FUNCTIONS OF ACQUISITION DIRECTION

6-1. Delivery Schedules

a. Army acquisition is a function that fulfills a need for equipment or to replenish stocks. The amount of materiel to be acquired is based on studies performed by inventory managers working for the commodity commander. These studies result in the issuance of directives to purchase materiel and are called acquisition requests or directives. The basic mission of those engaged in contracting is to timely acquire materiel or services in the open market at fair prices from responsible sources. The inventory manager is the coordinator of all supply management data relating to proposed acquisitions. The decision to buy and the issuance of the acquisition directive is his responsibility.

b. The contracting officer first learns what is required when he receives and reviews an acquisition directive. Discussion of contracting problems and interchange of information between personnel of the requiring activity and purchasing activity prior to that time will contribute to an efficient contracting operation. Planning and coordination for contract action, therefore, should begin far in advance of preparing an acquisition directive as timely, prompt coordination can help identify contracting problems at an early stage and lead to timely solutions.

(1) *Time of delivery.* Time of delivery depends on the time required to process the documents, produce the materiel, and secure delivery. A considerable portion of acquisition time is consumed in administration and production, and a long leadtime means that stocks must be ordered well in advance of expected receipt and that greater amounts of stock must be on hand to provide support during the acquisition period. The desired time of delivery governs the date on which an acquisition directive should be issued. Inventory and acquisition managers must work together to establish a realistic leadtime for proposed acquisition. An unrealistically short leadtime places the contracting officer in a difficult position.

(*a*) If leadtime is unrealistically short, the contractor may be able to command a premium price.

(*b*) The Government risks marginal or delinquent performance.

(*c*) Regulations provide that the Government is entitled to receive adequate consideration from the contractor for unexcused failure to meet the delivery date. Inventory managers must furnish the contracting officers with a sound basis for justifying sole-source or urgent purchases. Such reasons must be convincing and detailed; a statement such as, "In my professional opinion it is necessary to procure from a sole source," is neither adequate nor valid.

(2) *Rate of delivery.* Reasonable demands in the delivery schedule will often help the contracting officer to secure a lower price while concurrently increasing competition. Both the number of orders and the quantity of materiel stocked may be reduced by ordering a large quantity of stock to be delivered in increments. The contracting officer, with his knowledge of the production capabilities of manufacturers, can divide a proposed acquisition into economic production runs, meanwhile inviting the participation of small business concerns by means of setting aside a portion of the requirements for exclusive participation by small businesses and economic and socially disadvantaged individuals. Regular replenishments can be effected within short periods by requiring delivery in increments, eliminating the necessity for maintenance of a large operating stock.

(3) *Other factors.* In addition to urgency of need, other factors to be considered in establishing delivery schedules are as follows:

(*a*) The production leadtime considering quantities, complexity of design, and prior experience with similar articles.

(*b*) The acquisition administration leadtime including the time necessary to issue solicitations, preparation of bids or proposals by industry evaluation, and selective for awards.

(*c*) The time the contractor needs to comply with any other conditions of performance; i.e., submitting design data or preproduction models.

(*d*) The capabilities of small business concerns and the effect the stipulated delivery rate will have on their participation in the procurement.

(e) The time the Government needs to perform its obligations under the contract; i.e., approving plans or preproduction models, furnishing Government property, and performing tests and inspection.

(f) Industry practices.

(g) Market conditions and current capability of known suppliers.

(h) Transportation time and whether slight delivery adjustments will permit shipments to be consolidated to decrease costs.

6-2. Destination

a. The points to which supplies are to be delivered are generally stated in the acquisition directive and become part of the resultant contract. Effective management requires that stocks be positioned in storage depots in such a way as to conserve transportation funds, be responsive to contingency plan actions, and allow prompt supply to users. The destination has an important bearing on the contracting officer's selection of suppliers because he must select a responsive, responsible source whose price, including shipment to the destination cited, will be the lowest consistent with the requirement. The experience and knowledge of the transportation specialist, acting as a member of the contracting officer's team, contributes to the selection of contractors. Alterations in destinations may be required because of fluctuations in demand so that a proper stock position may be maintained. It is possible for the contracting officer to solicit bids or proposals on a free on board (f.o.b.) origin or an f.o.b. destination basis. For example, if an item has been bought f.o.b. and the cost of transportation from the contractor's plant to a new destination is less than to the old destination, a change order may be issued and the price reduced. If the cost of transportation to the new destination is higher than to the old, it may be better to continue with delivery as scheduled while meeting the demand at the new destination from another source of supply. Knowledge of the cost of rescheduling shipments permits the inventory manager and the contracting officer to select the most economical course of action.

b. Full carload or truckload lots are often less costly when shipped on a Government bill of lading, since special rates may be available to the Government that are not available to contractors. To determine whether use of a Government bill of lading is more economical, solicitations should generally request prices for both origin and destination delivery. When received, the contracting officer compares the transportation costs which the offerors submit with the cost of shipment on a Government bill of lading. Origin delivery is then specified if Government transportation is cheaper; otherwise, destination delivery is normally required. Origin delivery will also

be used, when the ultimate destination is not known or is likely to be changed or when supplies are destined for ultimate delivery outside the United States. When acceptance must be at destination, the solicitation shall be on an f.o.b. destination only basis.

c. There are other ways of keeping transportation costs low. These include the following:

(1) Consolidating small shipments to the same destination into carload or truckload lots.

(2) Consolidating deliveries to different destinations en route under single applicable tariffs and obtaining stop-off privileges for partial unloading or processing.

(3) Avoiding crosshauling and backhauling. (Crosshauling is transporting the same types of items in opposite directions between areas; backhauling is transporting the same items back and forth.)

(4) Shipping goods in a manner consistent with the physical characteristics of the materiel.

(5) Reviewing packaging specifications to see if they allow choice of less costly packaging or shipping methods. Thus, inventory managers should insure that packaging and delivery point requirements do not exceed the standards necessary to secure prompt delivery of the items. Extra distance, unusual packaging requirements, and nonstandard lots increase the cost of procurements.

6-3. Storage Requirements

It is Army policy that maximum use be made of depot facilities. At any given time some depots may be overstocked and some depots may be understocked. Stockage at depots is normally based on an established stock distribution pattern. National inventory control points prepare and forward storage space forecasts to higher headquarters and receive allocation of depot storage space. The storage capability of a depot being considered for a diverted shipment must first be taken into account before shipment because it may already be overstocked. In addition, consideration must be given to the physical characteristics of the supplies, the distance from a terminal of stock pre-positioned in support of contingency plans and the availability of transportation to that point. Contracting officers must consider the geographic location of the point of production in relation to the point of consumption and the cost of transportation. Whenever it is possible and economically feasible, maximum use is made of direct delivery from contractor to customer.

6-4. Fund Availability

a. The availability of funds is a basic consideration in every decision to buy. In the area of principal items the manager concentrates his studies on the provision of materiel in support of plans. Congressional appropriation acts provide the necessary financial resources. When secondary items and repair

parts are purchased, the manager must constantly consider the balancing of stocks, adjustments in safety levels, and the ratio of sales to inventory, as money in a stock fund is limited to obligation authority available. Every acquisition directive must cite the funds from which the purchase will be made.

b. The difference between the commitment and obligation of funds should be understood. A commitment is an administrative reservation of funds. An obligation is a legal reservation or a governmental liability resulting from an agreement to require supplies or services under a contract, purchase order, or other document.

c. Appropriations ordinarily are categorized as either 1-year, multiple-year, or continuing. These time limits define only the period for which the appropriations are available for obligation; the Government's appropriation structure rests on an obligation

rather than an expenditure basis. By statute, the funds provided in the annual appropriation acts are 1-year appropriations unless the act specifically provides otherwise. Thus, funds appropriated for 1 year cannot be obligated for expenditure in another fiscal year unless a multiple-year or continuing appropriation is involved. The Anti-Deficiency Act (31 U.S.C. 665) provides that no Government officer or employee shall authorize or create any obligation, or make any expenditure, in excess of an apportionment or administrative subdivision of appropriated funds. It requires the executive agencies to prescribe regulations that make it possible to fix responsibility for creating such overobligations or overexpenditures. To enforce this prohibition, the act requires administrative disciplinary action for those who inadvertently exceed their authority. It requires criminal penalties for those who do so knowingly and willfully.

Section II. ORGANIZATION FOR ACQUISITION

6-5. Organizations and Agencies Involved in Acquisition

a. *Department of Army Basic Acquisition.* The Army receives its basic acquisition direction from the Secretary of Defense. He has delegated acquisition authority to the Under Secretary of Defense (Research and Engineering (USD(R&E))), who develops broad policies and procedures for the entire Department of Defense. One major concern is the elimination of duplicative effort and expense; therefore, one responsibility of the USD (R&E) is to recommend assignment of acquisition responsibility among the services and the Defense Logistics Agency (DLA). He is assisted by a Deputy Under Secretary of Defense Research and Engineering (Acquisition Policy).

b. *Department of Defense Organizations.*

(1) The Defense Acquisition Regulatory Council is the (successor body to the ASPR Committee). The Defense Acquisition Regulation (to replace the Armed Services Procurement Regulation) is the regulation with which all DOD acquisition must conform. The responsibility for development and maintenance of the Defense Acquisition Regulation is vested in the Deputy Under Secretary of Defense Research, and Engineering.

(2) The Defense Acquisition Regulatory Council is comprised of one member from each of the services and the DLA plus a legal advisor. Its function is to develop and implement new and revised policy and procedures for the effective and efficient management of the DOD's business and contractual activities.

(3) The Armed Services Board of Contract Appeals (ASBCA) is the authorized representative of

the Secretary of Defense and the Secretaries of the Army, Navy, and the Air Force in deciding disputes arising under Government contracts. It is composed of qualified attorneys, appointed jointly by the Under Secretary of Defense (R&D) and the Assistant Secretaries of the military departments responsible for procurement.

(4) The Defense Contract Audit Agency performs contract and internal audits, some of which are required by law and others are discretionary. Cost-reimbursement contracts must be audited while contracts containing price redetermination clauses may be audited. Pre-award audits shall be performed prior to the negotiation of noncompetitive contracts in excess of \$100,000 and may be audited for proposals of a lesser amount. Likewise, the Government has the right to a post-award audit up to 3 years from the completion of the contract.

c. *Department of the Army Organizations.*

(1) Certain Army Staff officers, such as the Chief of Engineers, The Surgeon General, major commands of the Army, oversea command, and US Army Materiel Development and Readiness Command (DARCOM) are granted delegated acquisition authority. The DARCOM, as wholesale materiel manager, has this authority in order to perform its integrated materiel management mission. The Secretary of the Army, in addition to guiding the efforts of agencies actually engaged in contracting for materiel, has the assistance of specialists to insure that all acquisitions comply with the law and are in accord with the best interests of the Government.

(2) The Assistant Secretary of the Army, Installations and Logistics (ASA(I&L)), is delegated the Army's acquisition authority by the Secretary

of the Army. He, in turn, has a Deputy ASA(I&L) who acts for him in discharging his acquisition responsibilities, and a Director for Acquisition that is responsible for those activities of the ASA(I&L) related to worldwide direction and supervision of contracting.

(3) The Judge Advocate General of the Army provides legal counsel to the Secretary of the Army on matters relating to the legality of action in the acquisition program, legislative affairs, and incident thereto publishes opinions relating to acquisition contracting.

(4) The Inspector General studies contract awards, performance, administration, and terminations to insure compliance with the Army directives.

(5) The Army Contract Adjustment Board is charged with the administration of Public Law 85-804, Extraordinary Contractual Actions to Facilitate the National Defense. Where contract performance is essential to the national defense, the board can grant an amendment without consideration to a contractor in order to make performance possible. Where Government action has caused the contractor's loss, the board can grant an amendment without consideration even without Government action if such action will facilitate the national defense. Likewise, the board has authority to grant formalization of informal commitments and correction of mutual mistakes in contracts in order to facilitate the national defense. Heads of procuring activities may have this authority delegated to them for actions involving less than \$50,000. However, authority to approve any amendment without consideration which increases the stated contract price or unit price may not be delegated below the secretarial level except in extraordinary cases or classes of cases as to which the Secretary involved finds that there are circumstances clearly justifying delegation to a lower level.

(6) The Secretary of the Army designates those agencies that shall act for him in the field of acquisition contracting as purchasing activities. DARCOM and its subordinate commands are the major commands most involved in wholesale contracting. The contracting officer is required to refer many proposed actions, and findings to the head of the contracting activity for approval.

d. Other Federal Agencies. The Defense Supply Centers, the Office of the Deputy Director for Contract Administration Services, and the Office of the Executive Director, Acquisition and Production, DLA, and the General Services Administration (GSA) are all designated as heads of contracting activities and are involved in acquisition functions for the Army. The President and Congress maintain close surveillance over defense spending and evaluate the impact it generates on the national economy. Sev-

eral agencies are concerned with the placement and management of contracts by GSA, DLA, and the Army, such as the General Accounting Office (GAO) is an agency directly responsible to Congress. GAO evaluates Army acquisition procedure and recommends to Congress any changes that appear to be required in existing legislation. The GAO determines for Congress whether public funds are being spent in accordance with appropriations. The Comptroller General is the head of the General Accounting Office and has statutory authority to settle and adjust all claims for and against the Government.

e. Contracting Authority. Authority for acquisition contracting flows from the Secretaries of the Defense through the Military Departments to the heads of contracting activities. The contracting officer is appointed by the Secretary or the head of the contracting activity. The contracting officer role is separate from supply and disbursing functions so that he may exercise independent judgment in contracting actions. He is the single point of contact with industry in the business of contracting for supplies and services at a fair and reasonable price. The contractor looks to him for all decisions affecting the acquisition.

6-6. Types of Acquisition

a. The Army contracts for its supplies and services by either departmental, interdepartmental, or coordinated acquisition, and the type of contract established for any item determines the agency that will procure the materiel. Departmental acquisition is the action taken by the Department of the Army to procure materiel that is intended primarily for Army use. This is the materiel developed for and used by the Army, not by other services. Interdepartmental acquisition is the acquisition of supplies from or through Government departments and agencies outside the Department of Defense. Supplies used by other services and nonmilitary agencies, in addition to those used by the Army, are procured from the General Services Administration, the National Industries for the Blind, and the Federal Prison Industries. Coordinated acquisition is the acquisition of supplies and services from another service or agency within the Department of Defense. It includes single department acquisition whereby one department procures supplies to satisfy the needs of other military services for a particular commodity, and plant cognizance acquisition whereby one department procures certain supplies from a particular plant to satisfy the needs of other services. In single type acquisition the buying department is responsible, in general, for operational phases of acquisition planning. Personnel analyze the market, consolidate or divide requirements, and determine patterns for placement of orders in phases or at specific times in order to avoid high and

low periods in production and, thereby, secure the lowest possible price while fulfilling the needs of the requiring department. For instance, under cognizance acquisition, all propellers of a certain manufacturer are procured by the Navy for use on aircraft of all services. Commodity commands of DARCOM must submit their acquisition requests to agencies that have been assigned such acquisition responsibility.

b. The Director, Defense Logistics Agency, is responsible for administering the DOD Coordinated Acquisition Progress Program. Inclusion of commodities in this program requires that the group or class are—

(1) In common use by two or more military departments.

(2) Generally identifiable by acceptable specifications, plans, drawings, or purchase descriptions.

(3) Purchased in sufficient quantity on a repetitive basis to warrant conclusion that coordinated acquisition will result in overall savings to the Government.

c. Such assignments must include both peacetime and mobilization requirements. These assignments are made by Federal Supply Class whenever possible or by items or homogeneous groups of items to the military departments or DLA as appropriate. The Director, DLA, administers and supervises the DOD Coordinated Acquisition Program. He develops and maintains criteria and procedures for acquisition assignments, recommends new assignments or changes to existing assignments, and continually reviews and evaluates the operation of the program. Contracting activities are responsible for providing prompt service to the requiring departments and, in turn, the requiring departments, by mutual agreement, furnish advance planning data to the acquisition department on request.

d. The assignment of Federal Supply Agency was originally made by the Secretary of Defense. It was apparent, however, that many items within Federal classes were required only for the use of the services and, for some, the advantages of integrated management would be substantial while with others the advantages would be minor and the problems would be serious. This variance in the effect of integration led to item management coding as a means of segregating out of integrated classes the items on which integration was not advantageous. Thus, while an overall class might be managed by DLA, specific items in that class might be retained for integrated materiel management by Army or other services. This determination was made after an interchange of coding data resulted in agreement within the Department of Defense. Although the computation of requirements and management of such materiel after it physically entered the system was retained by Army, the DLA retained the purchase responsibility for all items in-

cluded in the Federal Supply Classes assigned to it, with certain exceptions. The Army may still contract for items that are in a research and development stage, atomic ordnance materiel, specialized supplies, or those that are still subject to rapid design changes, and it may make emergency acquisition, classified acquisition, or purchases of Army-managed or noncataloged items not in excess of \$10,000. It may also make one-time purchases of noncataloged items not contemplated as an item of supply in the supply system. Even though items are classed as exceptions by a military department, DLA will contract them at the request of a service. The General Services Administration is a participant in the DOD Coordinated Acquisition Program as it acts as the acquisition source for certain items in many classes for the Department of Defense. These are items which are used by all Government agencies and that are not used only in the Department of Defense. Where an item is on a mandatory Federal Supply Schedule, acquisition must be made through GSA.

e. The DOD Coordinated Acquisition Program has as its objectives eliminating duplication of acquisition operations between the military departments, improvement of efficiency and economy, centralization of control, continuing consideration of operations, and the benefits of large volume purchasing.

6-7. Methods of Acquisition

a. The basic and preferred method of contracting supplies and services in the Department of Defense is through formal advertising. Any other method of acquisition is an exception to this rule. Formal advertising has often been described as being time consuming, rigid, or mechanical. There is an element of truth to this statement because the procedures are established by law and regulation. Formal advertising is intended to insure that all qualified sources are given the opportunity to bid competitively. Likewise, the Government gains the benefits of full and free competition. Formal advertising requires that there be—

(1) Sufficient time to follow the inflexible formalities of established procedures. The urgency of a requirement may be such that the negotiated method of acquisition outlined in the Defense Acquisition Regulation must be used. If, however, a part of the purchase will satisfy the immediate need, the contracting officer should fill the urgent portion of the purchase directive by negotiation and still formally advertise the remaining quantity.

(2) Competition from at least two responsible sources. If only one firm has the capability to produce, or if one of two firms is so fully occupied as to be unable to participate, acquisition from one source by negotiation may be the only method of securing a reasonable price. In this situation reasonableness of price would be insured by analysis of costs and

comparison of previous prices during the negotiation session.

(3) Precise specifications so as to determine exactly what is required. A clear specification is helpful to both the contracting officer and potential contractors. Bidders then know the requirement and do not make erroneous assumptions, and the contracting officer is then able to evaluate bids on a common basis.

b. A basis for selection by price is necessary before formal advertising is practical. Normally, the responsive bidder who submits the lowest price gets the award. Factors other than price that are equally important usually cannot be considered unless spelled out in the invitation for bids.

c. The contracting officer must exercise judgment in determining whether formal advertising is to be used. If any of the above factors are missing, formally advertised procurement will not be fully effective. If formal advertising is practicable and feasible, it must be used as it is the preferred method of acquisition and it is, therefore, incumbent upon the inventory manager to provide the contracting officer with the basic ingredients for formal advertising; i.e., time, a basis for competition, and clear specifications.

d. The Defense Acquisition Regulation lists the exceptions to the requirement for formal advertising. The determination as to which method of contracting to use, formal advertising or negotiation, is not too difficult if the nature of the article, the time available, or the existence or lack of existence of competition strongly indicate or demand the use of one method over the other. Circumstances alter cases, however, and neither formal advertising nor negotiation is the preferable method of acquisition under all conditions. The fact that acquisition seems to fall within an exception does not necessarily justify negotiation. Likewise formal advertising should not prevail if advertising is impractical or negotiation is clearly the best choice. In the final analysis the decision to use either formal advertising or negotiation is based on a determination of which method will best serve the Government's interest. The use of formal advertising offers Government contracts impartially among suppliers, and obtains for the Government the benefits of free competition. Formal advertising will be used when—

(1) Precise and nonrestrictive specifications are available.

(2) There is adequate competition.

(3) There is sufficient time.

When one or more of the above conditions is lacking, negotiation is preferable.

6-8. Types of Contracts

a. Two general types of contracts are used in Government acquisition—cost-reimbursement and fixed-price. Under a fixed-price contract the contractor guarantees performance in exchange for a certain price. All risks are borne by the contractor. Under a cost-reimbursement contract, the contractor promises, in effect, that he will try to meet the performance requirements of the contract. In return, he is entitled to the reimbursement of allowable, allocable, and reasonable costs of performance in accordance with Section XV of DAR. He may also receive a fee.

b. The Government varies the terms of these two basic types to fit the wide range of defense acquisition. If a cost-reimbursement contract offers the contractor benefits beyond the immediate contract, for example, new ideas for commercial products, he may be willing to accept the work without a fee or even absorb a portion of the cost. Conversely, the Government may want to provide an incentive fee to encourage the contractor to special effort on some aspects of the work, such as cost or delivery time or certain standards of performance. The fixed-price contract may be varied also. If the risk is too great for a contractor to accept a firm fixed-price contract, but reason exists to expect reductions in cost or improvements in performance, a fixed-price incentive contract may be used. Fixed-price incentive differs from the cost plus incentive fee contract in that the contractor is responsible for all costs in excess of a ceiling price established in the contract. If acquisition costs are uncertain at first, but production experience may subsequently make a firm price possible, a fixed-price incentive successive targets contract may be used. In still another fixed-price situation, market conditions may make materiel prices and labor rates uncertain. Here, economic price adjustment provisions may be used to adjust the contract price for materiel and labor cost changes as they occur.

c. The Government, like any other buyer, wants its suppliers to assume as much risk as is fair. Therefore, it prefers to use firm fixed-price contracts whenever practicable. The Government also recognizes that unusual risks are involved in filling some of its needs. The goal is timely delivery of a quality product at a reasonable price. A close relationship exists between the type of contract used and the final price. Thus, use of the appropriate contract type for each acquisition is of primary importance in obtaining fair and reasonable pricing. The choice of contract type involves a delicate balancing of the contractor's risks against his expected reward. Some of the cost variables which may influence the estimate are the—

(1) Type and complexity of item being procured.

(2) Urgency of the requirement.

- (3) Period of contract performance.
- (4) Stability of the design.
- (5) Experience with the contractor.
- (6) Extent and nature of subcontracting.
- (7) Financial responsibility.
- (8) Administrative cost.
- (9) Adequacy of the contractor's accounting system.

- (10) Amount of research and development.

d. The fixed-price contract is the preferred basic type, variations of which are—

(1) *Firm fixed-price.* Under this arrangement, the contractor is required to furnish acceptable supplies or services at a specified price which is not subject to adjustment regardless of the actual costs of performance. Since the contractor bears all the risk, this is the preferred pricing arrangement. However, in the absence of price competition, or when cost or pricing data or performance uncertainties preclude attainment of a realistic cost estimate, another arrangement may be better. A firm fixed-price contract would be used when reasonably definitive specifications are available and where the impact of identifiable cost variants can be reasonably estimated. However, there are several disadvantages inherent in the firm fixed-price contract; i.e., it lacks pricing flexibility in an unstable market and it is inappropriate if the specifications are not clear and complete.

(2) *Fixed-price with economic price adjustment.* This arrangement is useful where there is reason to question the stability of the market or the labor conditions which will prevail over the period of contract performance. It provides for upward or downward price adjustment on the occurrence of the events stipulated in the contract. Any costs exceeding the agreed upon adjustment limit are absorbed by the contractor. Cost decreases are without limitation. Price adjustment contingencies should be limited to factors beyond the normal control of the contractor, such as increases or decreases in the cost of materiel. Amounts of labor or materiel required should not be the basis for price adjustment. Usually, these contracts contain a "trigger mechanism"; that is, a provision that the Government will defer repricing action until the increase or decrease equals plus or minus 3 percent of the original total contract price.

(3) *Fixed-price redeterminable.* This type of contract can be used where adequate estimates of total materiel and labor needs are not initially known or existing specifications are not sufficiently firm and accurate, or where sound initial estimates of the total cost of performance cannot be made. Two types of redetermination provisions are now in use—prospective and retroactive. The prospective type is appropriate for long-term production contracts in which a firm fixed-price can be agreed upon for only part of the contract period and where adequate cost

data are lacking at the outset to allow long range, accurate cost computation. Under a prospective redetermination contract, the price is adjusted at specific time during performance. This type of contract eliminates contingencies from the contractor's estimate. Conversely, it requires a considerable amount of accounting, is administratively burdensome, and part of the risk is transferred to the Government. The retroactive variant of redeterminable contracts provides for a retroactive price redetermination after completion of the contract and use of a price ceiling is mandatory. This type of contract cannot be used for anything but research and development contracts with value of less than \$100,000 and its use requires written approval by the head of the contracting activity.

(4) *Fixed-price incentive.* The objective of this pricing arrangement is to harness the profit motive to obtain greater economy and efficiency. The Government offers a proportionately higher profit for outstanding effort and economical performance, modest profit for mediocre performance, and low profit or even loss for inferior performance. The fixed-price incentive (firm target) contract is usable whenever a firm target and formula for establishing a final price which insure a reasonable incentive can be negotiated at the outset. The parties agree on a possible range of costs and initially negotiate: target cost—target profit—and price ceiling. An incentive share formula establishes the final price in accordance with the relationship which final cost bears to target cost. If the parties agree to a 60/40 sharing arrangement, the Government would pay 60 cents and the contractor would pay 40 cents for every dollar by which the final costs exceeded target cost up to the ceiling price, or limit of Government obligation. Costs incurred which exceed the ceiling price are borne by the contractor alone. Conversely, for every dollar by which final cost is below target cost, the Government would receive a 60-cent reduction from the target cost, while the contractor would increase his profits by 40 cents above target profit. The fixed-price incentive (successive target) contract is used when the available pricing data, though adequate for establishing an initial target price, are not sufficient for the negotiation of firm target price. In this situation, the Government may establish an initial target cost and profit, a price ceiling, a formula for fixing the firm target profit, and a specified production point incident to the contract. When that production point is reached, either a firm target cost is negotiated and the formula is applied to determine the firm target profit or the initial pricing arrangement is converted to a firm fixed price if further cost reduction is considered improbable. The danger in any fixed-price incentive arrangement is that an unrealistic target price may be negotiated. In that event, a cost

overrun may not reflect a lack of cost control by the contractor and a cost underrun may not reflect outstanding cost control. In addition to cost incentive, incentive may also, and as an addition to cost, be based on performance or delivery.

e. In general, cost-reimbursement contracts provide that the contractor shall be reimbursed for allowable costs incurred in the performance of the contract. Variations of the cost reimbursement are—

(1) *Cost plus incentive fee.* This pricing arrangement is used when the cost uncertainties and magnitude of possible overruns or underruns are too great to indicate use of a fixed-price incentive contract. It is often used for the development and testing of major weapons systems when the operational success of the development is probable, and for initial product development of major weapons where desired performance objectives are known. The contract provides for target cost, target fee, maximum fee, minimum fee, and share formula. Thus, if we have a development contract with a \$100,000 target cost, an \$8,000 target fee, a \$14,000 maximum fee, a \$2,000 minimum fee, and an 80/20 share ratio, the contractor's incentive for efficient performance is as follows: If costs are \$100,000, the contractor receives an \$8,000 fee; if costs are reduced to \$85,000, the contractor will be allowed to retain \$3,000 of the saving thus increasing his final fee to \$11,000. On the other hand if costs are increased to \$112,000, the contractor absorbs 20 percent of the \$12,000 cost overrun and his fee is reduced to \$5,600. The contractor's gains and losses, however, can only vary within the maximum and minimum fee limits.

(2) *Cost plus award fee.* In this type of contract the fee consists of two parts, a fixed amount and an award. The amount of the award fee is based on an evaluation by the Government of the contractor's performance. This type of contract is suitable for level of effort contracts when the measure of performance must be by subjective evaluation.

(3) *Cost plus fixed fee.* In this type of contract the contractor is reimbursed for all allowable and allocable costs and, in addition, is paid a fixed fee, which may not exceed the statutory limitations set forth in 10 U.S.C. 2306(d). For research and development contracts the limit is 15 percent of the estimated cost for performance; for supply and service contracts the limit is 10 percent. In cost plus fixed-fee contracts for architectural and engineering services, the fee may not exceed 6 percent of the estimated cost of the project, exclusive of fees, as determined by the Secretary concerned at the time of entering the contract. It is used in contracts for research, preliminary exploration, or studies to determine the feasibility of development, and where the level of effort required is unknown. It may be used for development and testing where a cost plus incentive fee

arrangement is not feasible. The cost plus fixed-fee arrangement provides minimum incentive and is costly to administer. The Government has all the risk of inefficient performance and the contractor has none.

(4) *Cost.* The contractor is reimbursed only to the extent of allowable costs. He receives no fee. This type of contract is applicable when the cost is uncertain and the use of a fixed-price type contract is precluded. It is also used for research and development work with educational and nonprofit institutions. A private contractor may accept this arrangement in order to gain production experience or to keep a plant operating. The cost contract is expensive to administer and provides little incentive to the contractor to keep costs down.

(5) *Cost sharing.* The contractor receives no fee and is reimbursed only for an agreed portion of his allowable costs. A cost-sharing contract is used when the item to be procured has, or can reasonably be expected to have, substantial commercial value to the contractor. It is appropriate for research and development work only when there is high probability that the contractor will gain substantial commercial benefits. The use of a cost-sharing contract requires approval from the head of the contracting activity.

6-9. Other Policies on Selection of Contractors

a. The Small Business Act of 1958 states that the Government should aid, assist, and protect, as far as possible, the interest of small business in order to preserve free competitive enterprise and insure that a fair proportion of Government contracts are placed with small business. Contracting officers are guided by Public Law 95-507, and the DAR in their determination of what percentage of a total purchase should be set aside or reserved for award to small business concerns or minority business. If the contracting officer questions the status of a small business or its ability to timely perform, he must submit a written notice to the Small Business Administration (SBA). Acquisition action is suspended until either SBA makes its determination, i.e., agreeing with or overruling the contracting officer, or a specific waiting period (15 working days) has passed. Small business specialists are appointed in acquisition offices to advise the contracting officer in this area. The contracting officer and an SBA representative jointly determine whether a procurement shall be set aside for the exclusive participation of small business. Sometimes the contracting officer knows from experience that sufficient bids will be received to permit award to small business concerns at reasonable prices. In this case he will restrict the advertising for bids to such firms. Acquisition directives should allow the

contracting officer as much time as practicable for administering small business set-asides as they require, and allow ample time for bid preparation and submission. Moreover, questioning of a bidder's small business status may delay award and possibly delivery of materiel.

b. The Labor Surplus Area Program has goals similar to those of the Small Business Program. Both are part of the larger goal of providing an effective mobilization base. It is DOD policy that concerns, both large and small, located in labor surplus areas, as determined by the Department of Labor, be considered for award of contracts, consistent with requirement needs. A labor surplus area, by definition, is where the percent of the available work force that is unemployed is at least 120 percent of the national average. The goals of the Labor Surplus Area Program are to foster the placing of contracts and facilities in labor surplus area and to assist such areas in making the best use of their available resources.

c. The Buy American Act restricts the acquisition of foreign-made goods by the United States Government. In supply contracts such goods cannot be purchased unless they are for use overseas, they are not available in the United States, or the cost of domestic goods would be unreasonable. The Department of Defense lists those items which have been determined to be unavailable within the United States. Items which are not on this list require a separate determination of unavailability by various staff officers within the military department, depending on the dollar volume of the purchase. Likewise, the DAR sets forth guidelines for the determination of whether the cost of buying domestic products is reasonable. Essentially, bids offering foreign products are increased (for bid evaluation purposes only) by adding varying percentages to the bid prices. If the lowest "foreign" bid is then still lower than the lowest bidder offering a domestic product, the award is normally made to the foreign bidder. Generally speaking, Canadian products are considered domestic products for the purposes of the Buy American Act.

d. Where it is necessary to test a product prior to purchase in order to insure required quality, materiel is subjected to a qualification test. Those items found to satisfy the requirements of an applicable specification are considered as qualified products. Specifications that require products to be tested and qualified are identified in the Defense Standardization Manual (M200). A qualification requirement is included in a specification where one or more of the following conditions exist:

- (1) The time required for testing in connection with the production would delay delivery.
- (2) Tests would require special equipment not commonly available.

(3) The cost of repetitive testing would be excessive.

(4) The interest of the Government requires that, prior to contract award, the product is satisfactory for its intended use.

e. Qualified products lists (QPL) identify the specification, the manufacturer, the item by part, model, or trade name. The qualified products lists are identified with the applicable class of the Federal Supply Classification to which the qualified product belongs. This list is established and maintained by the activity that develops the specification.

6-10. Contract Administration

a. During the performance of a contract, the contracting officer can initiate actions which affect price, time of performance, and other terms and conditions of the contract. Most of these actions are authorized under specific clauses of the contract. These are unilateral actions. Examples are change orders, inspection, terminations, and stop work orders. In these cases the Government includes the clauses in the contract for the specific purpose of being able to take such actions. In a Changes Clause, the contractor has a right to file for an equitable adjustment in the contract price and/or in the delivery schedule.

b. The Changes Clause is the most frequently invoked clause in a Government contract. It serves the vital purpose of enabling the Government to make necessary changes during performance to insure that the end result will be fully in accord with the needs of the Government. The Government has the right to make changes in drawings, designs, or specifications if an item is being specially manufactured for the Government and the change is within the general scope of the contract. In addition, the Government may unilaterally change the method of shipment or packing or the place of delivery in the contract.

c. The majority of performance problems which the Government encounters is either the technical requirements of the contract or the time of performance. Much of the difficulty in the technical area is in the interpretation of specifications. To insure that the Government receives a quality product for a fair price, it conducts testing and inspection of the supplies against the requirements as prescribed in the drawings and specifications. The inspection or test will vary from relatively simple methods to complex procedures.

d. If the contractor unexcusably fails to perform in the manner specified in the contract, the Government, by contract clause, has the right to terminate for default the whole or any portion of the contract. In such cases, the contractor may be responsible for excess costs of recontracting. Likewise, if all or a portion of the materiel is no longer required, the Government has the right to terminate for convenience. In such cases, the contractor must be paid for items

already accepted and for work in progress on the terminated portion of the contract. He also may be allowed reasonable profit.

e. A very important area in contract administration is the settlement of disputes which arise between the Government and the contractor. The standard Disputes Clause states in part "except as otherwise provided in this contract, any dispute concerning a question of fact arising under this contract which is not disposed of by agreement shall be decided by the contracting officer. . . ." Some examples of controversies which come under the Disputes Clause are: The amount of equitable adjustments under the Changes Clause or the Government-Furnished Property Clause; the amount of a termination settlement; whether a contract was properly terminated for default or whether the costs assessed were reasonable, and almost any other matter involving the interpretation of contract requirements. In such situations the duty of the contracting officer is similar to that of a judge deciding questions of fact. He provides, in writing to the contractor, his final de-

cision on the dispute. The contractor, of course, may appeal this decision within the subsequent 90 days to the Armed Services Board of Contract Appeals, or within the following 12 months, directly to the Court of Claims.

f. The Defense Contract Administration Services (DCAS) administers over 90 percent of all awarded contracts in excess of \$10,000. To accomplish its basic mission, which is generally defined as "technical and administrative services in support of buying organizations performed at or near contractor establishments; to facilitate contract performance and insure compliance with the terms and conditions of Government contracts," DCAS has been organized with a headquarters and a field organization comprised of nine geographic regions which, in turn, are divided into districts and offices. The purpose of DCAS is to centralize contract administration activities of the Department of Defense, achieve efficiencies, and improve management and operations, by implementing uniform policies, procedures, and organization.

CHAPTER 7

DISTRIBUTION MANAGEMENT

Section I. OBJECTIVES AND CONCEPTS

7-1. General

This chapter will be devoted to a discussion of distribution management. As the title implies, distribution management is concerned with the physical movement of items through the various Department of Defense supply and distribution systems. While primarily concerned with physical distribution, this chapter will also discuss, in broad terms, flow of requisitioning documents and the standard systems used to control, regulate, and evaluate the distribution system. This chapter will also address the functions of storage as an element of the distribution system and will also discuss the distribution of each of the 10 classes of supply.

7-2. Objectives of Distribution Management

a. Once quantitative materiel requirements have been determined, and supplies have been procured, supplies are the responsibility of the distribution system until issued to the ultimate user. The functions of the distribution system are:

(1) *Receipt*. The process of accepting supplies into the military supply system.

(2) *Storage*. The process of holding and caring for supplies prior to the issue.

(3) *Transportation*. The movement of supplies within the distribution system.

(4) *Issue*. The releasing of supplies to consuming or using activities.

b. Supplies ordinarily remain in the hands of users until they are consumed, become unserviceable, or become obsolete. Unserviceable supplies may be restored to serviceable condition by maintenance activities and returned either to the user or to the distribution system.

c. The purpose of the distribution system is to move supplies from the grower, producer, fabricator, or manufacturer to the user. This should be accomplished in as nearly a straight line as possible with a minimum number of stops. The goals of the distribution system are to be responsive to the user, to be sufficiently flexible to adapt to rapidly changing con-

ditions, to be economical in terms of use of physical and manpower resources, and to be resistant to disruption by either the forces of nature or enemy action.

7-3. Systems Concept of Materiel Distribution

a. As previously stated, the purpose of the distribution system is to move supplies from the producer to the consumer in as straight a line as possible. The ideal system would have an item of supply placed on a transportation mode at origin and shipped directly to the ultimate consumer. This system would eliminate all intermediate distribution echelons, thereby saving valuable resources for application elsewhere in the military system.

b. In reality, however, sophisticated systems have not yet been developed to support the ideal system. The forecasting of requirements, supply rates, and consumer locations is still an imprecise science as is the forecasting of production rates and raw material availability. This all necessitates stockpiling of supplies at some intermediate point to compensate for fluctuation of production or demand and to allow for the procurement of economical order quantities.

c. The benefits of intermediate stockpiling points have been briefly discussed. This benefit is not without cost as each point where supplies are diverted causes an expenditure of resources. It, therefore, follows that the minimization of resource expenditures can be accomplished by maximizing the throughput of supplies. This is the basic premise for the Direct Support System (DSS) and the Airline of Communication (ALOC) Subsystem, both of which will be discussed later in this chapter.

d. Depots in the Continental United States are established primarily to collect supplies from manufacturers. However, materiel may be delivered by a manufacturer directly to a user or to any other point in the distribution system where it is needed. If this were always feasible, depots in the United States would be needed only for reserves and would not enter into the normal distribution process. This is, in fact, the case for distribution of most bulk petro-

leum products. The Army maintains insignificant bulk petroleum storage in the United States. However, for most other materiel, the Army finds that, in order to overcome the uncertainties of production time, to compensate for fluctuations in demand, to permit procurement of economical order quantities, and to develop reserves for contingencies, depots in the United States are necessary. Nevertheless, whenever feasible, materiel is shipped directly from producer to requisitioner. Although some overseas stockage is retained (war reserve, safety level, and operational project stocks) most supply requirements for direct support units are met by direct delivery from CONUS depots, bypassing CONUS installations or overseas general support units and break bulk points when possible.

e. For overseas theaters, shipping time becomes the major factor in determining the need for stockage points. When air shipment is used, supplies may be delivered to an overseas theater in a matter of a few days. On the other hand, shipment by sea may require a month or more, including loading and unloading time. If the requirements for items are not predictable over a long term and if the consequences of shortages are serious, a fast mode of delivery must be employed or stockage points must be established in which sufficient quantities are maintained to give commanders a reasonable assurance that items will be available when needed. If the requirements for items are predictable or shortages are not of great consequence, minimum or zero stockage, together with sea delivery, might be acceptable.

f. Each combat unit carries its basic load and prescribed load list, which consists of enough supplies and repair parts to enable a unit to sustain itself for a limited time until it can be resupplied. Combat units normally draw their supplies from direct support units that maintain stocks of items most essential to continue operations of the combat units. These stocks are kept to a minimum, according to authorized stockage lists, to enable direct support units to maintain the same level of mobility as the units which they support. Since direct support units cannot carry all items required by combat units, another source, called general support, may be established. They will maintain a somewhat lesser degree of mobility but will respond rapidly to requisitions for items not stocked by (or out of stock in) direct support units.

g. A number of other considerations govern establishment of sources of supply, one or more of which may take precedence over the others. Some of these considerations are associated with US relationships with the country in which (or from which) operations are conducted. It may be neither desirable nor feasible to maintain large stocks of supplies in a friendly country. The host country may refuse to

furnish specific real estate or facilities, as one example; or it may be determined that, for short-duration operations, offshore stockage will give our forces greater flexibility. Other considerations are security, suitable storage areas, transportation networks, and the possibility of long-range offensive operations.

h. Another major consideration is the need for providing well-trained combat service support troops. To insure adequate training of combat service direct and general support troops, it is frequently necessary to authorize these support units stationed at installations in the Continental United States to stock supplies and repair parts, and to furnish this support to other units dependent on the installation for support. This concept provides an assurance that well-trained units are immediately available for deployment.

i. A final consideration is that organizations for combat service support units are kept viable by using a building block principle. Basic tables of organization and equipment units can be combined in a variety of organizational patterns to meet the specific need of the theater.

j. The preceding discussion suggests a flexible and highly adaptable conceptual model of the distribution system in which the source of supply and the user are the only constants. Yet, even the source of supply may vary; it may be a Continental US producer or an overseas US national or foreign producer. The source may also be rebuild operations or the cannibalization of unserviceable equipment. Nonetheless, the logistician's attention should focus on the objectives of the distribution system, rather than on a stylized organization for achieving these objectives. In this way, the logistician can concentrate on the advances in management techniques, the increases in numbers and complexity of items in the system, and the rapidly changing patterns and conditions of warfare.

7-4. The "Pipeline" Concept of Materiel Distribution

a. The administrative and physical structure through which demands for materiel are expressed and goods flow to the point of ultimate use is known as the distribution pipeline of supply.

b. The magnitude of the overseas pipelines may be envisioned from the fact that one quarter to one third of the stocks committed for specific overseas areas of operations are generally contained in the pipeline. Pipeline stocks for overseas operations have, at times, amounted to over \$10 billion; thus, the importance of accelerating the flow of goods to reduce investment, obsolescence, and administrative costs is readily understandable.

c. Some provision for storage is necessary to insure dependable supply. Along a military supply route,

there must be reservoirs where quantities of goods are temporarily held. The accumulation at each of these way-stations may be considered insurance against failures in prompt and adequate transmission of supplies from points in the rear. These reservoirs and carriers (ships, barges, trains, motor vehicles, planes, or oil pipelines) loaded with cargo constitute the logistics pipeline. Interpreted in a broader sense, the word pipeline might be considered as including all depots and depot operations worldwide. In this sense, the pipeline would include the stocks held as reserves for future contingencies, such as mobilization reserves or stocks accumulated for future military exercises, as well as materiel stored for early or immediate issue in support of the current activities of the military services at home and abroad.

d. The pipeline is both physical (with storage locations and transportation facilities) and administrative (requiring processing of documents). The physical structure of the pipeline makes possible the flow of materiel through the military distribution system from the point of receipt from procurement of production to the point of final use. Every physical element of the pipeline has a corresponding administrative element, because every movement of supplies requires processing of documents. Document processing time may exceed the time for the physical movement of supplies; thus, is an area for constant management attention.

7-5. Mobile and Responsive Support

a. Supply organizations must be sufficiently mobile to insure continuity of support, regardless of the speed with which the supported units are moving or the intensity of combat. The rapid movement of combat troops to achieve surprise or to concentrate power can only be effective if troops have sufficient supplies to achieve and hold their objectives. In addition, the ultimate measure of the effectiveness of such a maneuver may be determined by the capability to exploit the initial success. This again depends on the ability of supporting units to resupply and maintain the combat units. The capability of mobile and responsive support is the product of careful planning and disciplined training.

b. In order to develop and maintain a capability for mobile support, combat service support units must be trained to operate with minimum inventories. The key to success in this objective lies in substituting responsive supply action for stockage. Among the techniques under continuing development to increase the responsiveness of supply action are unitization of supplies and scheduled supply, together with improved transportation. Unitization of supply is the assembling of a number of items so that they can be handled as a unit. These units may range in size from pallets to standard 40-foot containers. Scheduled sup-

ply is the system by which the supplier calculates quantities of supplies for using organizations and ships them forward without requisitions on schedules agreeable to the user. Note: Paragraph 4-4*a*, AR 11-8, indicates that it is Army policy that shipments of supplies for initial support for deploying forces of a contingency operation will not be accomplished by "push shipments." The support shipments must be preplanned with the recipient participating in item selection, fully knowledgeable of shipment content and will be called forward. The speed of computation and communication inherent in automated processes makes it feasible to adapt principles of scheduled supply to subsistence, petroleum, and general supplies having uniform recurring demand or to those for which requirements are predictable with reasonable accuracy. In addition to unitization and scheduled supply, a responsive system should also be adaptable to direct delivery (throughput). Generally speaking, the communications zone transportation brings supplies into the combat zone and, wherever possible, into the areas where the supplies will be consumed. It can be anticipated that, as an attainable objective, a large percentage of all supply shipments will bypass the next lower echelon.

7-6. Environment of Support Operations

a. The tactical and physical environments in which combat service support operations are performed are important considerations in the analysis of the materiel distribution system. The tactical environment ranges from peacetime training to major warfare. The physical environment includes the configuration and conditions of the terrain, the weather, and the influence of the economic and technological development of the people native to the theater of operations.

b. In limited warfare, many of the difficulties of peacetime operations prevail in the face of a continuing responsibility to provide maximum support to tactical units engaging the enemy; however, in a major war, whether nuclear or nonnuclear, quantities of supplies are moved by every available means of transportation. Many uncertainties are introduced ranging from interdiction of supply lines to extensive radiological, biological, and chemical contamination of food and materiel.

c. For contingency planning purposes, it must be assumed that the United States could some day be in a nuclear war. In view of this assumption, logisticians managing the distribution system have an important responsibility. Survival and eventual victory after a nuclear holocaust may depend upon foresight in storing in protected facilities the materiel essential to survival, including the basic weapons of war.

d. The characteristics of the terrain strongly affect the configuration of the distribution system. Major supporting stocks for an island campaign may be placed on ships or on other islands; whereas, in a campaign conducted deep into enemy territory, a succession of stockage points and a complex transportation system may be required. Some other possible environments are:

(1) Operations on the North American continent with overland distribution capabilities from the supply to the combat troops.

(2) Operations in long but narrow terrain (e.g., Vietnam).

(3) Operations well within the perimeter of a large land mass (e.g., Central Africa). The distribution system in mountainous terrain will vary significantly from a system on flat terrain. Distribution in subarctic regions in the winter is vastly more complicated than in temperate areas, and each involves a set of problems different from those encountered in desert regions.

e. Finally, the level of technological development within the area of operations plays a vital role in design of the distribution system. A country replete with high-speed rail and highway routes, pipelines, and having numerous heavy duty landing fields poses far fewer distribution problems, assuming tactical air superiority, than an underdeveloped nation. Furthermore, the skilled people of a highly developed nation may often be recruited to supplement military personnel in performing the technical functions of the distribution system, whereas the local nationals of an underdeveloped country require intensive training and closer supervision.

7-7. Distribution Management Analysis

a. Specific approaches, using techniques similar to those developed for inventory systems analysis, can be developed for the analysis of the distribution system by:

(1) The activity for which materiel is being managed.

(2) Criticality of materiel.

(3) The environment in which supplies are being used (including the distance from the supply source).

(4) Classes of supply.

b. In the first approach, the distribution system is viewed in terms of the use of the materiel. Materiel is used for the:

(1) Support of personnel.

(2) Repair of equipment.

(3) Support of operations.

(4) Development and support of facilities.

The timing of distribution of materiel for the use of personnel is usually more critical than for the other elements. Personnel must have food daily and

clothing and individual equipment when needed, while equipment and facilities may be idled for lack of repairs for a period of time without equivalent consequences. Even a shortage of supplies required for operations (e.g., gasoline and ammunition), while serious, is not usually as catastrophic as starving troops. Therefore, food will normally be distributed by scheduled supply, that is, without requisition; but repair parts are normally supplied on presentation of a requisition. Stockage lists are based on the frequency of requests and essentiality, while stock levels are a function of the quantity requested. Materiel distributed in support of operations, however, must be delivered at times and in quantities dictated by the activities of the operations. Therefore, timing and density of deliveries will vary, but delivery as needed is essential. Consequently, these supplies, like food, are often distributed automatically rather than by requisition. The fourth category, materiel for development and support of facilities, poses special distribution problems. This materiel is usually bulky and required in large quantities. Extensive amounts of construction materiel are required in the early stages of an operation, the time when distribution resources are taxed to the breaking point. For that matter, throughout the conduct of an operation, construction materials must compete for distribution resources with supplies destined for combat troops.

c. The second approach to viewing the distribution system is by degree of criticality of the materiel being distributed. If difficulty is experienced in maintaining specific combat-essential equipment (e.g., helicopters), management emphasis may be placed on this aspect of the distribution system. This management emphasis may go so far as to separate the management of repair parts for the critical items into an essentially separate distribution system. In such a special system, transportation might be dedicated specifically to delivery of the materiel, warehouse space segregated for storage, and specialists organized to control issue of the materiel. Several types of materiel are always critical in combat operations and, therefore, their distribution may also have unique characteristics. All materiel considered essential to moving, shooting, and communicating comes under this category.

d. The third approach to viewing the distribution system (by the environment in which supplies are being used) was discussed in paragraph 7-6. The distance of the supported activity from the source of supply and the environment in which support must be accomplished are among the factors which account for the unique characteristics of distribution systems within each theater of operations. In planning for establishing supply systems in new areas of operations and for subsequent reevaluation of these

supply systems, each system may be considered, in a sense, a separate subsystem of the worldwide supply system, with as many aspects as practical designed to conform to a generalized model of the worldwide supply system.

e. In the fourth approach to viewing the distribution system, the 10 classes of supply are each viewed as subsystems. Each class has certain peculiarities which, in turn, influence its distribution pattern. Some perishable items, for example, may generally be procured overseas from the best available sources without concern for the procurement constraints inflicted on most other materiel. Meat, regardless of

where it is procured, must undergo veterinarian inspections before it is finally served. Another example is bulk petroleum products which are distributed whenever practicable by pipeline. They are purchased from commercial storage facilities and delivered by commercial carriers to installations in the United States, or shipped overseas to commercial or military tank farms. While the classes of supply are often managed by the same activities, stored in the same general areas, and delivered by the same transportation, there are enough significant differences to make their separate consideration a useful analytical tool for understanding the distribution system.

Section II. THE MILITARY STANDARD LOGISTICS DATA SYSTEMS

7-8. Introduction

The ever-expanding use of automatic data processing equipment and digital communications networks requires a common language of machine-sensible codes and formats. Such a common language must be recognizable not only to the machine and communications equipment but also to the human operator. Standardization and integration of data systems permit the output of one data system to be communicated and used as the input to other related data systems. A prime example of this standardization and integration of data systems is to be found in the Military Standard Logistics Systems (MILS). Currently, there are 10 standard systems or MILS that cover nearly all of the functional areas of the materiel life cycle. Each system was designed to standardize and automate the paper processes concerned with its area of responsibility, viz, requisitioning and issue of supplies, accounting for inventory, transportation and movement of inventory, performance reporting of supply and transportation phases and others. As the need for increased communication continues and as new systems are developed, new languages will be required and new MILS will be established. The current MILS are described below.

a. The Military Standard Requisitioning and Issue Procedures (MILSTRIP) was the first MILS and led to the growth of the remaining standard logistics systems. MILSTRIP prescribes uniform procedures for requisitioning and issue of materiel commodities between requisitioners and supply control/distribution systems and utilizes standard single line item format documentation. The requisition documents consist of conventional 80-column punch cards. The cards may be punched and transmitted by transceiver communications or may be completed manually and mailed. The manner in which the form is completed and submitted is dictated by the punch card format and communications capability of the requisitioner. Teletype and telephone communications also are authorized for high-priority requisitions, in which case

identical data in the columnar sequence of the punch cards are transmitted to permit rapid transcription to a punch card. Although the form and format are fixed, certain of the data may be manipulated and other data added to produce a variety of card documents essential to processing. Some common documents thus produced are requisitions, cancellations, passing orders, referral orders, supply status, follow-up, followup answers, materiel release orders, shipment status, materiel release confirmation, materiel release denials, notice of availability, requisition modifiers, and reconciliation requests. The implementing publication is AR 725-50.

b. The Military Supply Transaction Reporting and Accounting Procedures (MILSTRAP) prescribes and standardizes machine sensible codes, formats, uniform procedures and time standards for recording inventory management data passed between elements of a single distribution system or transmitted between various DOD distribution systems, i.e., inventory control and stock control activities, depot storage sites and post, camp, base, or station. MILSTRAP documentation is utilized to record demand data for the establishment of requirement levels, accounting for receipt and issue of DOD assets, performing inventories and processing of adjustments to accountable records, effecting logistics reassignments, and processing of special program requirements. MILSTRAP also provides for the small arms serial number registration and reporting between the DOD Central Registry and the Military Departments/Defense Logistics Agency Component Registries. The implementing publication is AR 725-50, Chapter 5.

c. The Military Standard Transportation and Movement Procedures (MILSTAMP) provides standard transportation movement procedures, codes, and formats which control the movement of cargo into and through all segments of the Defense Transportation System. In doing so it interfaces with the supply procedures in MILSTRIP. MILSTAMP also

prescribes the preparation of intransit data cards (IDC's) at the shipping activity and their subsequent completion by the receiving activity, plus port receipt and lift data for export shipments. These data are essential to measure actual performance against transportation time segments prescribed in the Uniform Materiel Movement and Issue Priority System (UMMIPS) and to support the performance evaluation requirements of the Military Supply and Transportation Evaluation Procedures (MILSTEP). The implementing publication is DODR 4500.32-R.

d. The Military Supply and Transportation Evaluation Procedures is the system that evaluates the MILSTRIP supply requisitioning performance data and the MILSTAMP transportation performance data against the time standards of UMMIPS. These input data are mechanically manipulated to produce standard output reports by military department and by distribution system to reflect, by issue priority, the elapsed time for requisition submission, supply source processing, cargo handling time, and intransit time by each segment of the transportation pipeline by point-to-point and carrier performance. MILSTEP also assists in the evaluation and maintenance of UMMIP's time standards, as well as determining supply systems workload and materiel availability. The implementing publication is AR 725-50, Chapter 13.

e. The Standard Contract Administration Procedures (MILSCAP) provides the standardized uniform procedures, record formats, data elements, and response times utilized in the interchange of automated contractual data between contract administration activities, buying offices, contractors, inventory control points, and other user activities. It is essentially a procedure to automate the various phases of contract administration to include contract abstracting, contract payment notification, shipment performance notification, destination acceptance reporting, plus other segments for future implementation into the 1980's. The implementing publication is DODM 4105.63-M.

f. The Military Standard Petroleum System (MILSPETS) has been established to provide automated standard procedures, forms, formats, data elements, codes and methods for interservice/agency use relative to the management of petroleum products. Unlike the other MILS, MILSPETS is commodity rather than functionally oriented. To the maximum extent practical, standard data elements, codes, and formats of other MILS will be used in MILSPETS procedures. This includes the applicable provisions of UMMIPS. The implementing publication is DOD 4140.25-M.

g. The Military Standard Billing System (MILSBILLS) is the system that prescribes

standard automated procedures and formats for billing and collecting for direct delivery from contractors, for reimbursable sales of DOD stock fund materiel, for appropriation financed materiel and reimbursable sales from the General Services Administration. The implementing publication is AR 37-12.

h. The Department of Defense Activity Address Directory (DODAAD) is the standard system designed to provide identification codes, clear text addresses, and selected data characteristics of organizational activities needed for materiel requisitioning, marking, shipping document preparation, billing and similar applications. This system is used by the military down to unit level and by General Services Administration and other civil agencies. The Directory, DOD 4000.25-D, is maintained at the Defense Automatic Addressing System (DAASO), at Dayton, Ohio and is published on microfiche in two parts: code to clear text address and Zip Code sequence. The implementing publication is AR 725-50, Chapter 9.

i. The Military Assistance Program Address Directory (MAPAD) is a standard system designed to provide the addresses of country representatives, freight forwarders, and customers-within-country required for releasing Foreign Military Sales (FMS) and Military Assistance Program (MAP) and grant aid shipments. The addresses are also required for distribution of related documentation. The MAPAD addresses are provided by representatives of foreign governments for use in receipt of materiel purchased under the FMS Program and by US military assistance advisory groups for receipt of materiel under the MAP Grant Aid Program. The master automated file is maintained by the Defense Automatic Addressing System Office (DAASO), Dayton, Ohio. The implementing publication is the MAPAD Directory DOD 5105.38-D.

j. The Defense Automatic Addressing System (DAAS) is a real time, random access digital computer system linked to the automatic digital network (AUTODIN). Its basic purpose is to automatically route or pass supply transactions to the correct recipients. This system embodies the integration of logistics and telecommunications into a single data processing system. The DAAS is operated by the DAASO and has two automatic switching centers, one each at Dayton, OH and Defense Depot, Tracy, CA. Each is capable of full operation when the other is down. The system is in continuous operation 24 hours per day 7 days per week. The implementing publication is AR 725-50 Chapter 14.

k. The Uniform Materiel Movement and Issue Priority System (UMMIPS) is that system established for use in the requisitioning and movement of materiel from and within the DOD distribution system. In itself the UMMIPS is not a separate MILS.

It is the DOD time accounting or measuring system that establishes common or uniform time standards, priorities, and language for use in those MILS such as MILSTRIP, MILSTRAP, MILSTAMP, MILSTEP, and MILSPETS. As a time measuring procedure it is an integral part of each of these systems, measuring and evaluating each segment of the order-ship time. The overall objective of the UMMIPS time standards is to provide guidance in satisfying a customer's demand within the cumulative time prescribed for the assigned designator. It tells the customer within his urgency of need when he can expect to receive the requisitioned item. At the same time it tells the supplying logistician how fast his response must be. An understanding of the MILS requires an understanding of UMMIPS, the "rule book" for all segments of the order and ship time that are subject to time frame measurements or evaluation.

7-9. Establishing Priorities for Processing Requisitions and Shipping Materiel Under UMMIPS

a. The Uniform Materiel Movement and Issue Priority System is applicable to the requisitioning and issue processing of all items under the management of military departments, defense agencies, and, by agreement the General Services Administration, for items in their depot program. The time standards prescribed cover interservice supply support operations for items normally stocked. Standards prescribed assume that the items required are in stock and available for issue; consequently, the standards do not reflect procurement lead time. In the movement and issue of materiel, it is necessary to identify the relative importance of competing demands for the logistics system resources, i.e., transportation, warehousing, paperwork processing, and inventories.

UMMIPS provides a ready basis for expressing the relative importance on requisitions and other materiel movement transactions through a series of two-digit codes known as priority designators. The increasing use of automatic data processing systems in handling supply and transportation documents makes this concise codification of precedents essential to the operation of the Department of Defense distribution system. Placed in the proper data field of the supply and transportation documents, the priority designator insures appropriate handling of competing demands.

b. In the requisitioning and issuing of materiel, the priority designator is based upon a combination of factors which relate the mission of the requisitioner (force/activity designator) and the urgency of need or the end use (as indicated by the urgency of need designator). The force/activity designator (a roman numeral) is assigned by the Joint Chiefs of Staff or by each military service. The urgency of need designator (an alphabetical letter) is determined by the requisitioning activity. With certain exceptions, these two factors will enable the requisitioning activity to determine the priority designator (arabic numeral). In addition to using the priority designator for the requisitioning and issuing of materiel, it may also be used for retrograde movement of reparables, the return of excess, and other special circumstances. The 15 priority designators provided in the Uniform Materiel Movement and Issue Priority System have been placed into three priority groups. Each priority group qualifies for different processing time standards as shown in Figure 7-2. These priority groups are compatible with the transportation priorities described in the Military Standard Transportation and Movement Procedures.

c. A priority designator of 03 may be used by all activities regardless of force activity designator for

STANDARD DELIVERY DATES

PRIORITY GROUP	PRIORITY DESIGNATOR	CONUS OR* INTRATHEATER	OVERSEA*
ONE	01 THRU 03	7 DAYS	11-12 DAYS
TWO	04 THRU 08	11 DAYS	15-16 DAYS
THREE	09 THRU 15	28 DAYS	66-81 DAYS

*FROM DATE OF REQUISITION TO RECEIPT OF MATERIEL.

Figure 7-1. Standard Delivery Dates

medical or disaster supplies or equipment required immediately for prolonging life, relieving suffering, or expediting recovery in case of injury, illness or disease, or avoiding or reducing the impact of epidemics or similar potential mass illness or diseases. A priority designator of 03 may also be used by all activities regardless of force activity designator for emergency supplies or equipment required immediately for controlling civil disturbances, disorder, or rioting. A priority designator of 06 may be used by all activities regardless of force activity designator for emergency supplies of individual and organization clothing to active duty military personnel who are actually without the clothing required.

d. The commander or, in his absence, the acting commanding officer will authenticate the assignment of priorities by placing his signature in column *d* of DA Form 2064 (Document Register for Supply Actions) for each request submitted containing priority designators 01 through 08.

e. The required delivery date is the calendar date when materiel is required by the requisitioner. Delivery data standards are established based on priority designators. Requisitioning activities determine if the priority delivery date standards will meet their requirements. If so, no required delivery date is placed on the requisition. The requisitioner can assume, unless requisition status information indicates otherwise, that delivery will be made not later than the priority delivery date established. However, dates other than those established by the priority delivery date may sometimes be used under certain specified conditions. In the case of Foreign Military Sales, where the US commitment requires delivery to the customer at point of origin, a required availability date, which does not include a transportation element, is used.

f. Requisition documents indicating priority designators 01 to 08 will be transmitted under priority communications precedence. Documents with priority designators 01 through 03 will be transmitted under communications precedence "operational immediate" if the commander on the scene determines that the situation so warrants. Documents indicating priority designators 09 through 15 may be transmitted by transceiver, courier (when appropriate), or US mail, consistent with military service policy, geographical considerations, priority designators, and required delivery date. To evaluate the total performance under this priority system, the date placed on the requisition is the date of transmittal from the requisitioning activity concerned to the appropriate supply source.

g. Conditions will exist in which available assets cannot satisfy all current demands and due-outs for a specific item. A due-out, as applied to supplying installation, is that quantity of materiel requisitioned by ordering activities which is not immediately available for issue, but which is recorded as a stock commitment for future issue. Inventory managers establish procedures for release of assets in short supply in accordance with the following criteria:

(1) Automatic procedures will sequence demand by priority designator, and by requisition document number date within equal priority designators.

(2) Manual review will be made when release of assets may result in failure to satisfy a firm commitment for delivery of materiel to a military assistance recipient or failure to satisfy a requisition reflecting a Joint Chiefs of Staff assigned project code. Decisions on the selection of demands to be satisfied will be based on schedule due-in significance of Joint Chiefs of Staff assigned project codes, and acceptability of substitute items.

Section III. REQUISITIONING STORAGE

7-10. The Flow of Requisitioning

a. The operation of the distribution system is normally initiated by the submission of requests by using units or supply points. A Department of the Army Form 2765 (Request for Issue or Turn-In) is the request prepared by using units at the supply points. Department of Defense Form 1348 (DOD Single Line Item Requisition System Document) is the manually prepared requisition and 1348M the one for automatic data processing. DD Form 1348 consists of four copies. This form is used as a manual requisition, manual followup, and manual cancellation. It may be prepared by typewriter, pencil, or ballpoint pen. DD Form 1348M is used for the followup answer, supply status, notice of shipment from supplier to customer, rerouting the requisition, direction of a shipment to a customer, redistribution

of supplies between storage sites and between users, and the notification of action taken in response to a directive to ship from a storage point.

b. The frequency of submitting requisitions is the prerogative of the requisitioner; except for subsistence items, the distribution system does not normally prescribe scheduling of submission. Requisitions are submitted when required to meet stockage objectives or to meet specific priority requirements other than stockage. Requisitions for subsistence items, however, are submitted in accordance with schedules established by the Defense Personnel Support Center in the Continental United States. Overseas, the Materiel Management Centers (MMC's) of the applicable support activities submit schedules for Class I in accordance with existing and anticipated strength requirements. The supporting depot or inventory

control point within CONUS is required to maintain liaison with the installations they actively support. Overseas, the MMC and general support storage activities maintain customer assistance officers to provide this contact. Under normal circumstances, the support depot or inventory control point maintains a contact folder for each activity or installation it supports. Overseas, this folder is maintained at the MMC and general support storage activity. Problems arising between visits are usually filed in this folder if they can be suspended until the next visit.

c. Requisitions usually move back through the distribution system from the direct support unit toward the inventory control point. The first stockage point which the requisition reaches that is authorized to carry the materiel in stock should be able to fill the requisition. At each stockage point not authorized to carry the materiel, the requisition is recorded as a demand (a prescribed number of demands in a given time period authorizes the stockage point to stock the item of materiel) and a new requisition is automatically punched duplicating most of the information on the requisition. However, when the materiel requisitioned is not in stock but should be, then the supply point will either establish a due-out (meaning that the requisition will be held on file until a shipment is received at a stockage point) and so notify the requisitioner; or it will refer the requisition to another source by preparing a new requisition (referral order) duplicating most of the information on the requisition it received except for the address. The requisitioner will be notified of the referral of the passed requisition so that followup actions can be taken with the proper source.

7-11. Storage

a. An essential element of national defense is the ability to apply military power where and when needed. Supply is an integral part of that ability and storage is a vital link in the chain of supply from producer to consumer. Storage is the instrument by which the fluctuating rate of consumption is kept in balance with the more uniform rate of production. It cushions the effect of interruption in production upon the availability of materiel, and by proper timing and placement, insures effective logistical support of the military force.

b. Supplies in storage must be cared for and protected to insure that they will be available in serviceable condition when needed. Storage should be planned so that supplies are always accessible, even during rapid expansion and contraction, and that space is used efficiently. Storage should be designed for efficient receiving, storing, care in storage, issuing, and accounting for supplies. Physical security from theft, sabotage, and overt enemy attack are also considerations. In addition, fire protection is a con-

stant concern, and protection from contamination by chemical, radiological, and biological agents may become an important consideration. There are two general classifications of storage space—covered and open.

c. Covered storage space is storage space within any roofed structure. This includes a variety of general and special-purpose structures. The general-purpose warehouse, constructed with roof, sidewalls, and endwalls, provides excellent storage for many kinds of items. The single-story warehouse with a floor at railroad car floor and truckbed level has become the standard type of warehouse because of its low operating cost. Truckloading platforms may be on one side of the general-purpose warehouse and carloading platforms may be the length of the other side. The dimensions of the platforms and the aisles of the warehouse should afford maximum convenience for use of mechanical handling equipment commensurate with efficient use of storage space. Refrigerated warehouses usually are divided into two distinct areas: chill space in which the temperature can be controlled between 32 degrees and 50 degrees F. and freeze space in which the temperature can be controlled below 32 degrees F. Flammable storage warehouses are used for storing highly combustible materials such as paint and oils. The unique feature of these structures is that they are normally separated into compartments divided by firewalls. Explosives are generally stored in above-ground magazines or in igloos. The igloo is a type of magazine that is generally constructed of masonry with an arch-type of roof covered with dirt. All ammunition storage facilities require detailed attention in construction and maintenance to the explosives-safety regulations which govern their use.

d. Other types of closed storage are controlled-humidity warehouses, transit sheds, dry tanks, and sheds. The controlled-humidity warehouse is normally a sealed general-purpose warehouse with devices for controlling humidity. Transit sheds are basically roofed sheds placed beside or immediately adjacent to docking facilities to protect supplies from the weather during loading and unloading. Actually, most transit sheds are not open-sided as the name implies but are buildings with closed sides and ends and are generally used on wharves and piers. Dry tanks are used for long-term storage and are constructed entirely of steel except for a concrete floor. Such items as automotive parts that are not intended for use for a number of years are kept in dry tanks. A shed is a roofed structure without complete sidewalls and endwalls. A shed is used for storage of materials that require maximum ventilation or materials that do not require complete protection from the weather. This type of building is a compromise between open storage and warehouse storage. Tarpaulins may be used as sidewalls for the protection of

supplies. Tarpaulins, however, make identification and care of stocks more difficult.

e. Improved open storage space is an open area that has been graded and hardsurfaced or prepared with a topping of some suitable material to permit effective materials handling operations. In addition to the hard surface, the open storage space must have adequate drainage to afford protection from wet ground conditions. Hard surfaces are often improvised from steel mats or from pallets or timber. It may sometimes become necessary to use unimproved open storage space. This practice often results in the waste of many man-hours when stocks have to be moved and sorted when earth surfaces erode or become muddy. When operational conditions make the use of unimproved open storage necessary, care should be taken to provide drainage, to mark aisles clearly, and to block up and maintain stacks of supplies frequently.

f. The Department of Defense specifies certain policies regarding uniformity in the development of storage layout plans. Aisle widths are limited to the size required for the operation of materials handling equipment needed to handle the unit loads in storage. In general, items are stored by Federal supply class (the first four digits of the National Stock Number). Relative activity or turnover is a primary consideration in determining storage locations for materiel. Stock moving daily and retail bin stock should be stacked near the shipping or breakout area. The size of an individual item affects not only the amount of storage space allocated to a Federal supply class but it is also considered in the location of that class within the storage area.

g. Most items of general supply do not require special handling or storage methods, although similarity, popularity, and size of the item must be considered. Others, however, require special handling. For instance, some materials are handled in bulk; hard fuels require special storage areas and handling equipment; and liquids handled in bulk require pumps, pipelines, and special storage tanks. Consideration is given to the special handling and storage of all such materials in planning the storage areas. When the materials have a limited storage life, care must be taken to insure that the oldest stock is issued first. Many foods must be kept in refrigerated areas or in temperature-controlled areas. Many items have a high resale value and are subject to pilferage. This materiel is located in buildings or areas where security control can be established and the entire storage operation rigidly controlled.

h. The rapid selection of stocks for shipment, efficient handling of receipts, and the maximum use of storage space depend upon the effective use of an adequate stock locator system. The basic element of a good locator system is the record card for each

stock item. Record cards contain the stock number, the unit of issue, nomenclature, and location of the lot for each item stocked. Since storage areas are laid out and marked in rows, stacks, and levels, a floor plan enables the stock picker to match the location shown on the location card with the floor plan and then proceed directly to stored item. When stock in any one location is exhausted, that listing is lined out on the locator card. Normally, only one location should be maintained in bin storage. Proper selection of locations for issues and consolidations of receipts aid materially in keeping the number of locations to a minimum. Periodic location surveys verify recorded locations against actual locations. Also, stock locations are verified at the time normal stock inventories are taken as a part of the regular inventory procedure. Maximum utilization of storage space (especially the covered storage which is always at a premium) takes precedence over the minimizing of the number of locations. Inefficiencies in use of storage space may result from an attempt to minimize numbers of locations for items by such practices as specifying warehouse locations for one item and only one, thus producing wasted space when the particular items are in short supply. A better practice is to concentrate on maximum use of storage space, depending on locator cards for efficient selection of needed items for shipment. Consolidation of locations, while very helpful, becomes secondary to efficient space utilization.

i. One of the most important functions of the storage operations is receiving. Receiving operations concern the manner in which supplies are brought into the storage operation. Prompt and accurate processing of receipts is, therefore, a prime requisite of an effective storage operation. The details of receiving operations are, for the most part, dependent upon types of supplies to be handled, distance supplies must be moved, types of materials handling equipment available, and physical characteristics of the storage installation. Planning is necessary in all receiving operations. Certain preconceived plans or ideas must be followed by the personnel unloading supplies. Planning begins when the first information is received that identifies a shipment. The central control office of storage operations establishes overall priorities based on receiving workload as indicated by shipment arrival notices, initiates action to obtain unusual equipment and labor requirements, assigns available vacant space to meet demand brought about by incoming stocks, and insures the dissemination of advance receiving information to warehouse personnel and other personnel concerned. Because of many factors over which storage officials have little control, day-to-day receiving operations fluctuate more than any other activity. As a consequence, a high degree of coordination among the separate receiving

operations is necessary. Incoming shipments also must be checked carefully to include the tallying of incoming supplies, the inspection of the supplies, and the checking of documents. The transportation officer must be notified of all over, short, or damaged shipments which are received. The unloading, checking, and storing of security or sensitive items, such as alcohol, narcotics, and strategic and critical materiel, require special handling and, in most cases, special methods of documentation.

j. The issue process of the storage operation is heavily dependent upon the efficiency in which the receiving function is accomplished. Issue operations deal with the selecting of stocks in storage and readying them for shipment. The accuracy and timeliness in which the supplies are received and placed in storage determine the ease with which the issue function can be performed. As was the case in receiving, planning plays an all-important role. Beginning with the receipt of notification for issue, commonly called a materiel release order, through the selection of stocks and the physical packaging and packing to final marking and unitizing, priorities are established by the production control element. Outgoing shipments must also be checked cautiously to insure proper selection, accurate documentation, adequate packaging, and correct labeling. It is through the issue function that we insure delivery in good condition to the ultimate consumer.

7-12. Materiels Handling

a. Materiels handling involves the movement of materiels and supplies from one place of operation to another without affecting their value and without performing any productive operation. The basic principles of materiels handling require that:

(1) Packing techniques such as palletization and containerization must be standardized and coordinated with the design and procurement of materiels handling equipment so equipment at a storage location can handle all supplies delivered. Furthermore, the design of aisles and stacks in all types of storage facilities must be coordinated with types to be procured. Platforms, ramps, and intransit storage facilities must be compatible with both the materiels handling equipment and the unloading characteristics of the transportation media.

(2) The flow patterns of movement of supplies should be designed and periodically reevaluated to allow for maximum utilization of materiels handling equipment. Idle equipment is often an indication of inefficient flow patterns. A straight line between pickup and delivery points is the shortest distance between the points, a consideration which is sometimes overlooked. Loading, unloading, and turnaround space is required. One of the basic objectives of materiels handling is to organize handling so that the number and distances of moves are minimized.

(3) Each piece of equipment should do a variety of jobs. However, with the many sizes, weights, and types of packaging, there must be a number of types of equipment available in each installation. Consequently, careful management is required to optimize their use. Materiels handling must be planned and organized so that the most efficient piece of equipment is available for each moving or stacking operation. For example, a forklift might be appropriate to move pallets a short distance, but a tractor-trailer train would be far more efficient for movements over longer distances.

(4) Advance planning of materiels handling methods and equipment is performed concurrently with other planning activities and undertakings. Some of the factors requiring advance planning include the need for protection against weather and breakage, the possibility of using unitized loads, the opportunities for standardizing equipment and methods, and the possibility of combining materials handling methods. Safety is always a prime planning consideration.

b. The use of physical labor in the handling of materials in storage must be kept to a minimum. While a certain amount of troop labor is necessary, this labor is by no means free; in fact, the long-term cost to the Army of using troops for labor makes it imperative that logistics managers exhaust other alternatives before turning to troop labor. One of the intangible costs of troop labor is the disruption of unit training; and in wartime, when manpower is always short, the use of large numbers of troops to handle supplies manually in storage installations must be avoided. Consequently, the planning for procurement, operation, and maintenance of materiels handling equipment is important.

c. The automation of warehouse operations is not often practicable in the Army except in major depots. Nevertheless, a brief review of some of the principles of automation of warehouses will be useful since most of these principles govern any type of system and are, therefore, useful in analyzing and improving manual and mechanical as well as automated warehouse operations. The automated warehouse employs mechanical devices to supply the power and control of movement of goods under general (often remote) human guidance. These categories of equipment are employed: Materiels handling equipment such as belts, towlines, tractors, and skate wheel and roller conveyors; mechanized storage and dispensing systems, or static storage combined with retrieval equipment; and information processing equipment to maintain status records on item location and inventory levels, to process orders, and to issue picking, marshalling, and dispatching instructions. Gates and switches are used to control the movement of goods on conveyors and other materiels handling equip-

ment. Neither mechanization nor automation need be applied totally and uniformly to a warehouse. The state-of-the-art is still sufficiently limited so that complete automation must be confined within fairly tight limits of item or container size and weight. The principles of automation which can be applied to both mechanized and manual systems require:

(1) Location of fast-moving items near the control center and marshalling and shipping operations.

(2) Arrangement of belts, skate wheel conveyors, and other devices so that items or crates can be moved directly and in one continuous operation from the receiving point to the storage location, or from the storage location to the shipping point.

(3) Control devices to signal when a decision is needed. When one element of the system has reached full capacity, a decision is needed to shift operations to another element of the system. When there is a malfunction in the system, that portion of the system affected must be stopped until the malfunction can be corrected.

7-13. Care of Supplies in Storage (COSIS) or Materiel Readiness

a. Any program for the care of supplies in storage is an important responsibility of the storage and quality control managers. The program is concerned with determining through a systematic quality control procedure the type of storage best suited to the item, the methods of inspecting the stock's condition, and the application of all required preservation, packaging, packing, and marking to insure that the item is maintained in a ready-for-use condition. The degree of activity involved in each phase of the program depends upon the type of item, type of storage, the military level of packaging and packing afforded, anticipated length of storage, probable end use, and other governing factors.

b. Serviceable and economically repairable unserviceable supplies and equipment will be stored in warehouses as space is available. Controlled humidity space will be utilized to the maximum practicable extent, giving priority to items for which controlled

humidity affords the greater degree of protection. When warehouse space is unavailable, items may be placed in shed storage, and, as a last priority, in open storage.

c. Modern storage aids (platforms, pallets, bin storage and materials handling equipment) should be employed to insure optimum use of storage space. All supplies shall be properly identified, classified by condition code, and properly marked for storage. Good housekeeping practices are essential to morale and safety, and all storage areas should be closed, and tears and ruptures in stacked or boxed subsistence should be closed with a patch or recovered.

d. All supplies, materiel, and equipment entering or in the Department of Defense supply system, including movement in or between oversea theaters, must be afforded the degree of preservation, packaging, and packing required to prevent deterioration and damage during shipment, handling, and storage. If possible, preservation, packaging, packing, and marking, including minor repair, are performed during inspection of mission stocks.

e. Unserviceable stock is recorded in appropriate accounts and held at the activity until disposition instructions are received; or it is shipped to an activity having a maintenance facility. The disposition instructions may be:

(1) Recondition and repair at the reporting depot, or ship to a depot having a depot maintenance facility.

(2) Obtain repair by commercial contract.

(3) Release the stock to the property disposal officer, after it has been declared surplus.

f. Modernization of storage and materials handling operations must be accomplished where improved supply response and/or reduced operating costs are possible. Processes recommended in TM 743-200-2 were conceived with the objective of minimizing manual handling in favor of maximum mechanized handling. The ultimate objective is the mechanized movement of materiel from time of receipt until it reaches the shipment consolidation point, over the most direct route possible, and with the fewest practicable en route handlings.

Section IV. DISTRIBUTION OF ALL CLASSES OF SUPPLY

7-14. Pattern of Distribution of General Supplies

a. The previous sections of this chapter have covered the principles of distribution which are applicable to all classes of supply. In this section and the following three sections, each class of supply will be discussed in order to illustrate the peculiarities in the distribution of the classes of supply which have man-

agement significance. This section and Section V deal with the bulk of supplies for which the distribution patterns are similar. Sections VI and VII discuss the distribution of petroleum products and ammunition. They are discussed in separate sections because each is highly critical to combat operations, is fast moving, and has peculiarities which necessitate a distinct distribution subsystem. The distribution of medical

supplies is discussed along with general supplies because, although a separate system has been established for medical supply, its mechanics are essentially the same as for other classes of supply.

b. Except for items authorized for local or offshore procurement, general supplies are centrally procured and stored in Continental US depots. Items which have been coded for central management by the Defense Logistics Agency are procured by that agency and stored in depot space allocated in the agency. Army-managed items are also procured and stored in allocated space in Continental US depots. Installations in the United States requisition these centrally managed supplies from the depots for delivery to installation storage points or directly to using units. When possible, general supplies are shipped from the wholesale CONUS depot system to the requisitioner. The process of shipping directly from the CONUS depot to the requisitioner, thus bypassing the CONUS installation, is referred to as the Direct Support System (DSS) and is explained in detail in Section V.

c. For overseas theaters, materiel is shipped from Continental US depots to major overseas stockage points or directly to the general support or direct support unit. The process of bypassing the intermediate supply echelons is again referred to as the Direct Support System and is being utilized to provide classes of supply II; III (Packaged); IV, Selected; V (Missile System Components only) VII; and IX, Materiel.

d. For those items which are authorized for local or offshore procurement ("local" is the term used for procurement by posts, camps, or stations in the United States, its possessions, and Canada; "offshore" is the term used for procurement of military needs anywhere other than the United States, its possessions, and Canada), action is accomplished by the local procurement agency. The materiel so purchased is normally delivered directly to the requiring organizations.

e. Depending on the urgency of a requirement, the most economical mode of shipment available is selected. However, to meet the processing time standards, which are based on priorities, modes of transportation other than the most economical are often selected.

7-15. Distribution of Class I Supplies—Subsistence

a. The Defense Personnel Support Center of the Defense Logistics Agency procures food, clothing, textiles, footwear, individual equipment, and medical and dental supplies for the Army. The center manages about 1,200 food items cataloged for use by the military services. These cover the range of foods com-

prising the American civilian diet, as well as special or operational-type rations required for military use. The center also provides survival-type food for the Civil Defense Program and has initiated Direct Supply Support to commissaries overseas. DLA is the proponent for this system. It is much like the Army Direct Support System in concept but is a separate system under DLA. The center procures food through four regional headquarters and 21 permanent or seasonally operated field buying offices. Each region operates storage and distribution facilities for perishable foods. Each region procures nonperishable subsistence for delivery to depots or installations.

b. For installations in the United States, nonperishable food items are stored at designated distribution points. Perishable subsistence supplies are usually obtained from regional marketing centers operated by the Defense Personnel Support Center. Local procurement is authorized in emergencies. The distribution activities at installations include warehouses for nonperishable subsistence, cold-storage facilities (including freezers, chill rooms, and vegetable storage), ration distribution activities, issue commissaries, and commissary storage. The chief of the veterinary activity is responsible for procurement and surveillance inspection services for subsistence, encompassing acceptability for quality and wholesomeness, and for determining potential aspects of chemical, biological, and radiological hazards pertaining to subsistence items and household supplies for sale to authorized customers.

c. Class I supply in the theater of operations is primarily a problem of bulk and tonnage. It is also a refrigeration problem for some items. Class I supplies move through supply channels at a fairly uniform rate. To minimize supply administration and physical handling of supplies, the system uses as few intermediate echelons as possible. Experience data at each supply echelon permit virtually automatic issue of rations based on unit strength. Related items, such as salt tablets, soap, insecticides, and toilet tissue are also issued through Class I channels.

d. Perishable subsistence may be obtained overseas from local sources through offshore procurement techniques. Whenever practicable, these supplies are procured by bartering techniques, using surplus agricultural commodities from the United States as a medium. The use of offshore procurement of perishables adds to the menus offered to troops, but it increases the health hazard. As a result, the functions of the Military Veterinary Services in inspecting foodstuffs becomes particularly significant. When feasible, perishables are delivered directly to organizational breakdown points. Nonperishables are distributed through the normal general support-direct support system.

7-16. Distribution of Class II Supplies— Secondary Items of Equipment Authorized in Allowance Tables and Items of Supply Including Expendable and Consumable

a. As mentioned in paragraph *f*(2)(*a*), the Defense Personnel Support Center procures and manages most clothing and individual equipment used by the Army. This materiel is stored in Continental US depots.

b. Personal clothing in the Continental United States is usually distributed through clothing sales stores and issue points. The clothing sales store provides an economical method of issuing and selling personal clothing to military personnel. Personal clothing includes dress uniforms, fatigues, boots, and headgear which must be in serviceable condition and in the possession of enlisted personnel. The clothing sales stores are direct support system customers; therefore, they requisition directly on the wholesale depot system.

c. Clothing is distributed overseas through the DSS to the general support stockage point and the direct support unit, except that overseas installations may establish and operate clothing sales stores in accordance with the same regulations used in the Continental United States.

d. In the case of Class II items other than clothing, they will be provided both in CONUS and overseas through either the self-service sales stores (source of expendable items) or the supporting direct support unit (nonexpendable TOE items) both of which are DSS customers.

7-17. Distribution of Class IV Supplies— Construction Materials

Construction materials present a special problem because of their intrinsic weight, large quantities required, the extraordinarily wide variety of hardware, and the vulnerability to pilferage. Most construction supplies are procured by the Defense Logistics Agency's Defense Construction Supply Center. Since commercial-type construction materials are readily available, the need for storage of these supplies is not extensive in the United States. However, the requirement for the storage and shipment of Class IV items to overseas areas is extensive. Distribution both overseas and in CONUS of this class of supply is through the DSS.

7-18. Distribution of Class VI Supplies— Personal Support Items (Ex- change and Shipstore Type)

Distribution of personal demand items (e.g., cameras, watches) in the Continental United States is managed outside the logistics system using nonap-

propriated funds. Distribution overseas, however, involves the distribution system and poses a major problem of pilferage. The items are easily converted to cash, making them an attractive target for thieves. Therefore, security measures are intensive throughout the distribution process. Locked and guarded containers and warehouses are provided at terminals and major overseas storage points. Personal demand items are usually controlled separately within major overseas depots and distributed to sales points (e.g., post exchanges) directly from the distribution centers.

7-19. Distribution of Class VII Supplies— Major End Items of Equipment Authorized in Allowance Tables

The significant difference between distribution of major end items and secondary items is that major end items are controlled by line item and distributed in accordance with carefully developed distribution plans, whereas secondary items are, in general, distributed on demand. Certain major end items are selected for stockage as an operational readiness float used for replacement of lost, destroyed, or uneconomically repairable items on one hand, or for immediate replacement of items to be repaired (repair cycle float) on the other. The physical distribution of these items both in CONUS and overseas is through the DSS.

7-20. Distribution of Class VIII Sup- plies—Medical Materiel and Re- pair Parts

a. The Defense Personnel Support Center procures and manages medical, dental, and veterinary supplies and equipment that are common to the three military departments. In CONUS, deliveries of medical materiel are made directly from Defense Logistics Agency depots to medical units, usually hospitals, located at CONUS installations. In overseas areas, medical materiel is shipped to installation medical supply activities and medical supply, optical, and maintenance (MEDSOM) units for further distribution to medical units.

b. The medical supply system operates separately from the rest of the Army logistics system, though the distribution patterns are similar. The reasons for separating medical logistics from Army logistics generally revolve around the criticality of the mission of the Army Medical Department, the catastrophic effects of shortages of medical supplies, and the fact that medical supplies are used almost exclusively by professional personnel of the Army Medical Department. The Army Medical Department plays an important role in maintaining the combat effectiveness of units. The value of a combat-hardened soldier cannot be equated to a given number of raw replace-

ments; therefore, the medical treatment of wounded soldiers and those incapacitated by disease to return them to combat duties takes on great significance. It is the goal of the Army Medical Department never to permit an individual to die or be permanently lost for duty for lack of medical supplies. These important and humane considerations account for the separation of medical supply from normal Army supply.

7-21. Distribution of Class IX Supplies— Repair Parts (Less Medical) In- cluding Expendables and Consum- ables

Repair parts are provided through the DSS and the Airline of Communication (ALOC). The users draw their supplies from direct support maintenance units. Frequently, repair parts for combat-essential equipment are urgently required to return deadlined equipment to operation. The expedient supply of repair parts to meet these requirements has often resulted in special support systems. Highly expedited administrative techniques and rapid transportation are employed to insure the shortest possible response time to requisitions for urgently needed parts. For some items of equipment which must stay operational

(e.g., helicopters for air assault units), the entire repair parts system is intensively managed.

7-22. Distribution of Class X Supplies— Nonmilitary Support Materiel

The distribution system for items of supply to support nonmilitary programs (e.g., agricultural and economic development) depends on agreement with the foreign countries supported and with elements of the other departments of the Government (primarily the State Department). Usually, delivery of these items follows the same channels as general supplies for the Army except that they are normally distributed to the foreign government directly from a terminal or major oversea depot. The significance of Class X supplies is that they use resources that would otherwise be available for the distribution of Army requirements. Nevertheless, the supply of these items is often important enough to take precedence over some of the less essential Army items. When the Army undertakes to cooperate in international programs, it thereby commits itself to supplying the agreed-upon materiel even at the expense of its own distribution system, provided that critical operations are not seriously impaired.

Section V. THE DIRECT SUPPORT SYSTEM/AIR LINE OF COMMUNICATION

7-23. Introduction

a. The Direct Support System facilitates the movement of supplies from the Continental United States wholesale supply base directly to the consumer; e.g., direct support unit, bypassing the oversea storage activities or the CONUS installation supply division (ISD).

b. An integral part of the system is a logistics intelligence file (LIF) which provides intransit visibility of pipeline assets. The LIF effectively interfaces supply and transportation documentation to provide top level logistics managers an independent source of performance data and a complete overview of the total logistics pipeline. This integrated technique permits managers to precisely identify problem areas and to determine the most effective methods and procedures to support the Army in the field.

c. The Direct Support System has resulted in major improvements to the supply distribution/transportation system by providing:

- (1) Visibility of the supply/transportation pipeline.
- (2) Intransit data reporting to accommodate source to user containerized shipments.
- (3) Physical distribution system that maximizes source to user containerization techniques.
- (4) National distribution of stocks positioned

at designated depots to best support geographically oriented customers.

(5) Improved customer support by reducing order ship time for PD 09-15 requisitions (Figures 7-2).

(6) Interface of supply and transportation documentation.

(7) The elimination of intermediate level operating stocks.

7-24. Concept

a. DSS is a concept of supplying classes of supply II, III J, IV, selected V (missile system components only), VII, and IX materiel direct to supply support activities (SSA's from CONUS area-oriented distribution depots. To accommodate reduced response time to customer requirements, stock distribution policies must insure availability from the distribution depot for those items applicable to the appropriate theater/geographic area being supported. Classified/protected/sensitive items requiring signature service (see AR 55-355, and Appendix K of AR 740-26) and materiel requiring refrigeration will be shipped in accordance with current directives. The Eastern United States and the European theater of operations will be supported by the secondary item distribution depot at New Cumberland. Red River

DSS OST OBJECTIVES

(Priority Designators 09-15)

CYCLE SEGMENT	EUROPE*		CANAL ZONE	KOREA	OKINAWA	JAPAN	HAWAII	ALASKA	CONUS
REQUISITIONING AND PASSING ACTIONS	(3)	5	5	7	7	7	7	5	4
NICP PROCESSING	(2)	3	3	3	3	3	3	3	3
DEPOT PROCESSING	(3)	5	5	5	5	5	5	5	5
INTRANSIT TO CCP	(1)	2	2	2	2	2	2	2	NA
INTRANSIT TO CRP	NA	NA	NA	NA	NA	NA ^a	NA	NA	2
CCP PROCESSING, INTRANSIT TO POE, POE PROCESSING	(5)	10	18	14	14	16	11	13	NA
INTRANSIT POE TO POD	(1)	10	4	15	18	12	5	2	NA
POD PROCESSING	(1)	2	2	3	1	1	1	2	NA
INTRANSIT TO SEA	(1)	3	1	1	1	1	1	3	NA
CRP RECEIPT TO DELIVERY (CONUS)	NA	NA	NA	NA	NA	NA	NA	NA	1
SSA PROCESSING	(3)	5	5	5	5	5	5	5	5
TOTAL OST (CALENDAR DAYS)	(20)	45	45	55	56	52	40	40	20

NOTE: PD 01 THRU 08 WILL BE MEASURED AGAINST UNIFORM MATERIEL MOVEMENT AND ISSUE PRIORITY SYSTEM (UMMIPS STANDARDS) (CH. 2, AR 725-50).

*ALOC standards for Europe are identified in parenthesis.

Figure 7-2. DSS Order ship time for oversea commands priority designator 09 through 15.

Army Depot is the distribution depot supporting Central United States and Central and South America. Sharpe Army Depot will be the distribution depot supporting Western United States, Alaska, and the Pacific theater of operations. The CONUS support concept follows state line boundaries. This will facilitate distribution of stock based on actual demands as accumulated under the requisition activity address code. The distribution pattern for DSS is shown in Figure 7-3 & 7-4. Materiel stored and stockage levels maintained at the distribution depot will be managed by the national level item manager. The method used to determine the range of items and the stockage quantities for the distribution depot will be based on customer demands at the Na-

tional Inventory Control Point (NICP) level as determined in supply control studies.

b. Figure 7-3 & 7-4 graphic depiction of the manner by which DSS requisitions and materiel flow in CONUS. CONUS requisitions flow from the supply support activity to the installation supply division for editing the validity of supply data, funding, and fill in accordance with prescribed fill/pass logic. The requisitions are then transceived to the Defense Activity Address System (DAAS) for routing and gathering of logistics intelligence file information. Upon arriving at the activity managing the item, (Army, GSA, DLA inventory control point) release will be directed from a depot or depots. The materiel release orders will be passed through the DAAS

DSS AOD SUPPORT AREAS

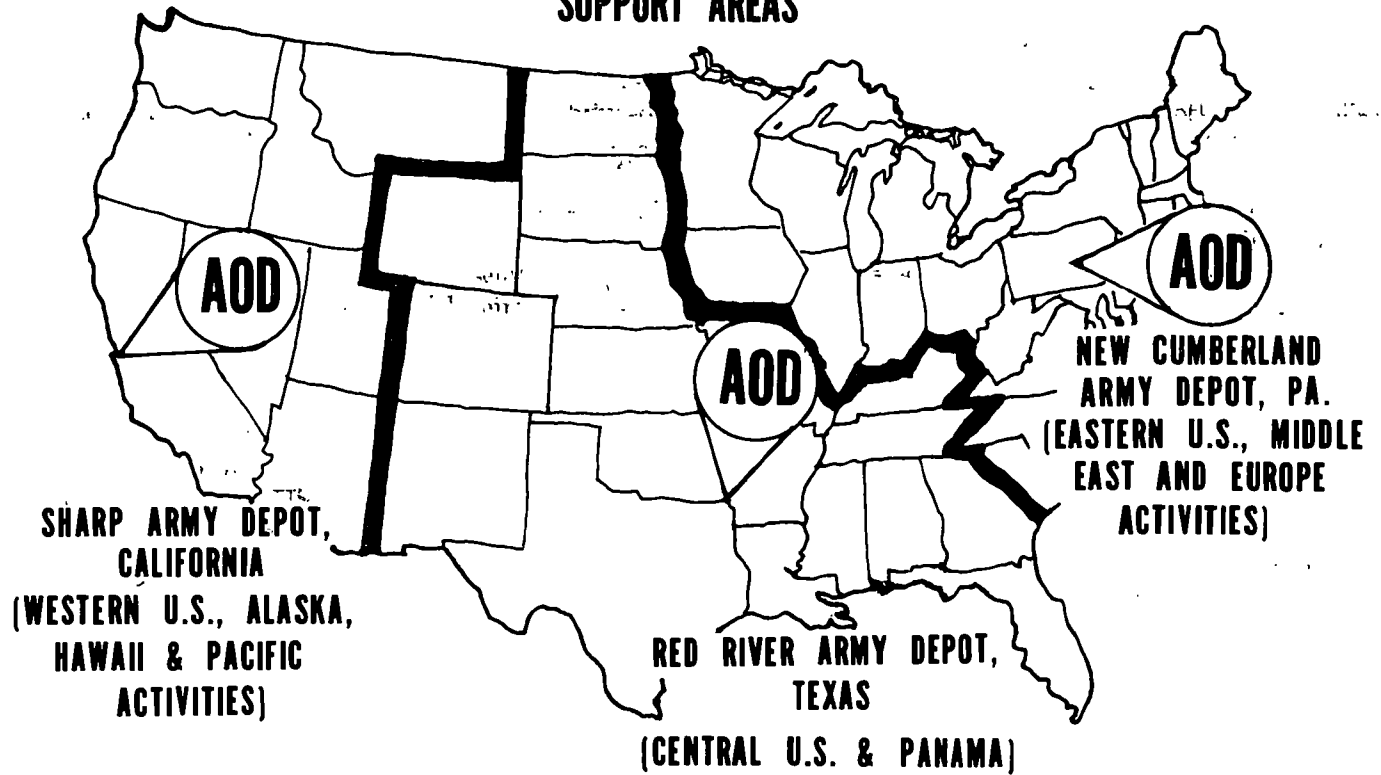


Figure 7-3.

DSS - CONUS FLOW OF REQUISITIONS AND MATERIEL

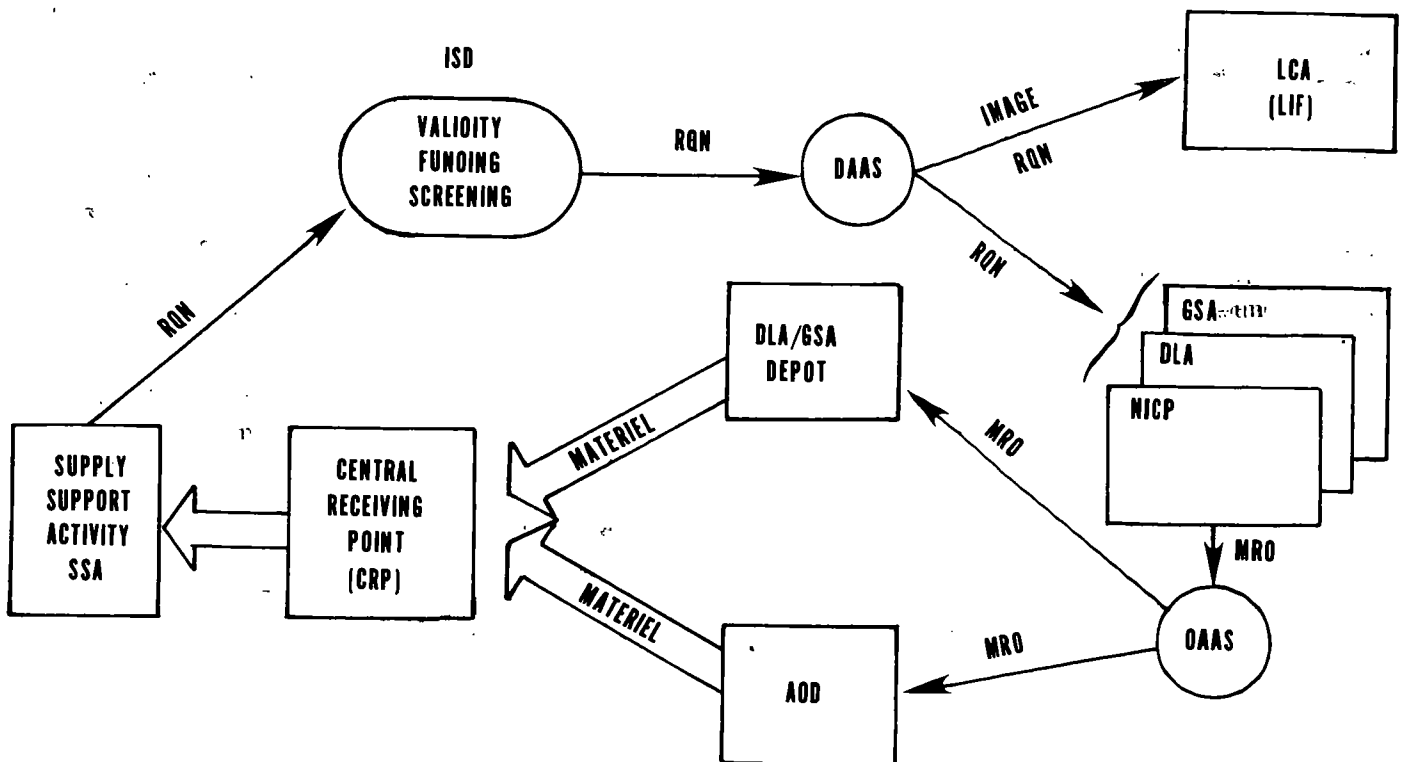


Figure 7-4.

where image copies of all transactions will again go to the LIF. Shipments to CONUS customers from the distribution depot/DLA/GSA will be forwarded to the installation central receiving point (CRP) and will not be directed through the consolidation/containerization point (CCP). The CRP will receive all shipments of DSS materiel from commercial sources (vendors), parcel post, mixed cargo shipments of DSS and the non-DSS materiel and mixed cargo shipments for DSS participating and nonparticipating units. In those cases where all of the supplies on a particular truck (most CONUS shipments will be by commercial truck) are for one or a few customers, the truck will deliver the supplies directly to the customer after being checked through the CRP.

c. Figure 7-5 is a schematic diagram showing the requisition and supply flow for overseas areas under the DSS. Oversea requisitions will flow from the SSA to the in-country installation supply activity/materiel management agency (ISA/MMA) for editing the validity of supply data, funding, fill in accordance with the prescribed DSS fill/pass logic. Requisitions will flow in the manner explained in the preceding paragraph for CONUS requisitions. To provide maximum container utilization and through-container service, east, west, and gulf coast consolidation/containerization points located at the distribution depots are used to support overseas customers. Materiel destined for overseas shipment will be consolidated in VAN or 463L pallet loads. The CCP for the east coast is located at New Cumberland Army

OVERSEA DSS SYSTEM

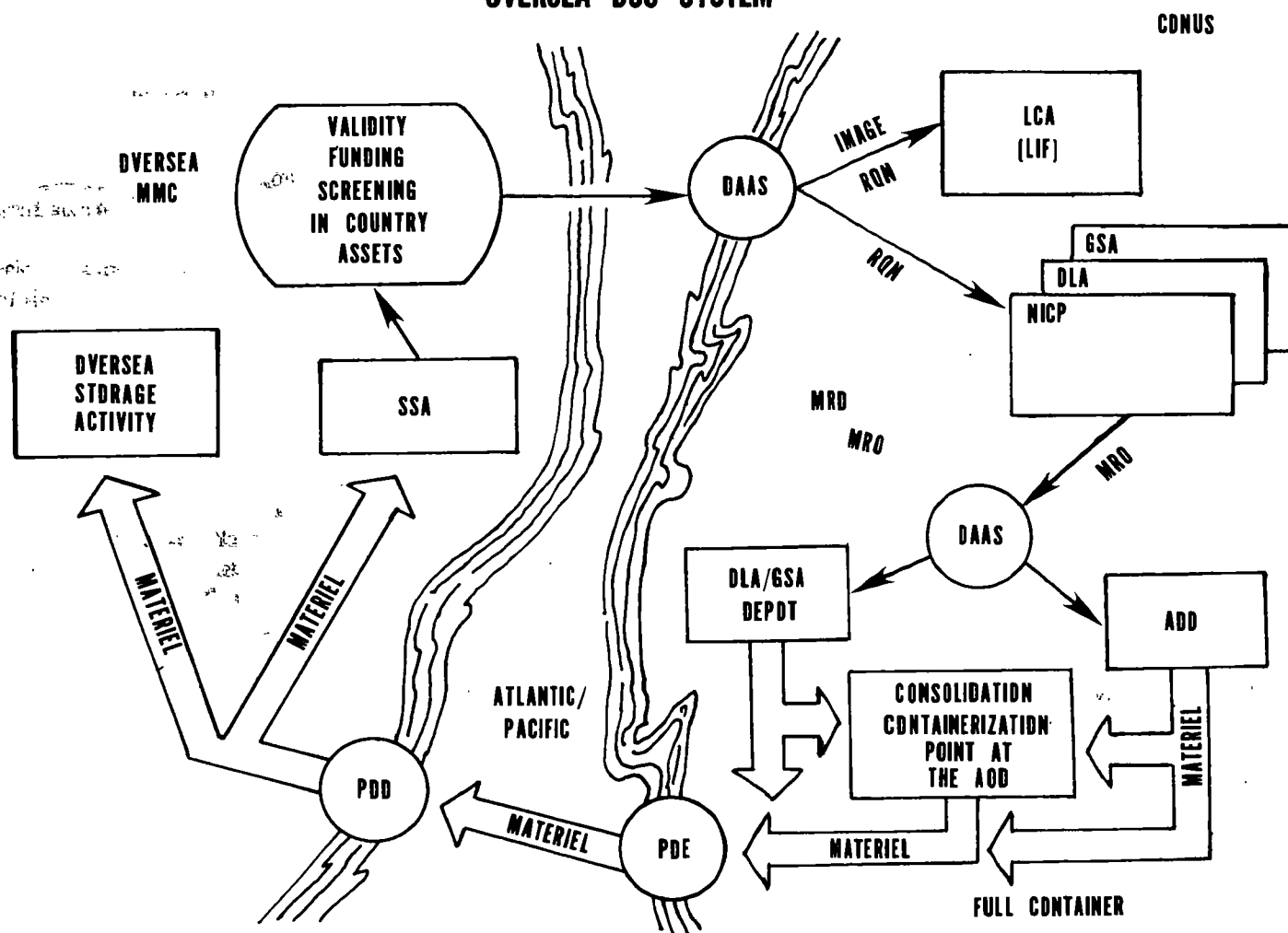


Figure 7-5.

Depot. The CCP for the west coast is Sharpe Army Depot. The CCP for the gulf coast is Red River Army Depot. Oversea shipments (less than VAN/463L pallet loads will be forwarded to the appropriate CCP for consolidation/containerization). Non-distribution depot shippers may ship full VAN/464L pallet loads direct to one consignee provided sufficient cargo is accumulated in 1 day to justify a shipment at point of origin. Less than full VAN/463L pallet loads of DLA/GSA materiel for overseas shipment will be directed to the CCP for consolidation with Army-managed materiel. The containerized shipments will bypass the break bulk points/overseas storage activities and move directly to DSU's/drop points (exception: ISA MMA safety level replenishment requisitions). Shipment unit integrity by consignee will be maintained throughout the process. Not all units will have sufficient volume for economical utilization of direct container shipments. To provide the benefits of DSS to these units and attain maximum through-container service, logistics support plans will be designed to take advantage of clustering units for delivery service. Full-container loads may continue to be shipped to single consignees; however, to achieve full-container utilization, sequential loading or drop-point loading of a single container for delivery to multiple consignees will be used. The integrity of each SSA's shipment and associated documentation will be maintained in the containerized shipments. The container will be delivered in accordance with the in-country DSS distribution plan. High-priority requisitions PD 01-08 for air shipments will be loaded on minipallets (standard 40" x 48" wood pallets with plastic shrink film securing materiel to the pallet) when materiel is forwarded to a single supply support activity or drop point. Materiel for more than one SSA or drop point is loaded on an Air Force 463L pallet with a divider between each SSA's or drop point's materiel.

d. The Logistics Control Activity is responsible for maintaining the logistics intelligence file for all Army requisitions. This file provides the management information necessary to monitor system performance and gain intransit visibility of supplies in the pipeline. Additional information relative to the data available in the file and the method of gaining access to this information may be obtained from the Logistics Control Activity, or FM 38-704.

e. Stockage at the overseas storage activities (Figure 7-5) is limited to war reserve and project stocks or an essentiality based safety level for those items not included in the reserve or project stocks that qualify for storage. The essentiality based safety level or war reserve and project stocks provide a surge tank to meet PD 01-03 and NORS or to accommodate pipeline interruptions caused by acts of God, labor disputes, or interdiction in time of war. In

CONUS the installation supply division's (Figure 7-6) stockage will be limited to contingency stocks and those required to support non-DSS customers satellited on the ISD for support. Peacetime operating stocks for installations are authorized only to support non-DSS customers.

7-25. Airline of Communications (ALOC)

a. ALOC capitalizes on and is a further refinement in Direct Support procedures designed for Class IX repair parts. The goal of the ALOC is to provide repair parts, in a 20-day order ship time (OST) cycle, regardless of the priority designator on the requisition. The LSOC OST goal for the various segments of the distribution system are as follows:

NG Goals	
Segment	Goal
In-Theater Processing-----	3
NICP Processing-----	2
Depot Processing-----	3
Intransit Containerization/Consolidation Point-----	1
CCP Processing—Cargo Accumulation -----	2
Intransit POE-----	1
POE Processing-----	2
Intransit POE/POD-----	1
DOD Processing-----	1
Intransit to DSU-----	1
DSU Processing-----	3
Total -----	20

b. The flow of requisitions and material under ALOC is basically the same as under DSS. ALOC cargo is consolidated by unit at selected distribution depots on Air Force cargo pallets and moved by Military Airlift Command aircraft to the overseas Aerial Port of Debarkation (APOD). The APOD is given 1 day to clear the cargo and the overseas commander has 1 day to deliver to the general/direct support level. This system is designed to operate on a 7-day a week delivery cycle.

c. Transportation Priority 4 (TP 4), the use of airspace available transportation, reimbursed at surface rates becomes an integral part of the ALOC concept. The increased use of airlift will result in an increased allocation of airspace available transportation for retrograde cargo to CONUS. Priority on the use of retrograde air is to be given reparable items being returned to CONUS for overhaul/repair. Second priority is to be given excess reparables being returned to CONUS stock.

d. Employing ALOC will make the repair parts distribution system much more responsive, thereby, enhancing the combat readiness of US Army elements overseas.



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CHAPTER 8

DEPOT MAINTENANCE MANAGEMENT

Section I. INTRODUCTION TO THE ARMY MAINTENANCE SYSTEM

8-1. Significance of Depot Maintenance Management in the Logistics System

a. The maintenance function within the DA consists of servicing, repairing, overhauling, and modifying weapons and equipment. It is the largest of the functions embraced by the general term "logistics," and it is the largest consumer of resources. Shop facilities in which maintenance functions are performed range in size from as little as 1,000 square feet to more than 3,000,000 square feet. Maintenance activities are found wherever the forces of the United States are located—from ships at sea to land installations located in all types of terrain and climatic conditions.

b. Within the Department of the Army, the US Army Materiel Development and Readiness Command (DARCOM) is assigned the responsibility for Budget Program (P7M), Depot Materiel Maintenance and Support Activities. Nearly 38,000 persons are presently engaged in P7M activities, worldwide. The depot maintenance program is often referred to as the "wholesale level" of maintenance logistics and is the area to which ensuing discussions apply.

c. If for no other reason, the magnitude of the maintenance program, when viewed in terms of the amount of funds and the number of personnel involved in its function, is reason enough to justify the emphasis placed upon the management aspects of it. The contributions of the maintenance program, however, relative to supporting a desired level of unit and materiel readiness, is the prime reason why this area of logistics is significant and important. The fundamental purpose of logistics is to increase the combat effectiveness of the Army in the field. In this respect, the absence of a maintenance program or the existence of one that is ineffective, would result in an excess amount of inoperable equipment; an increase in equipment downtime; and the loss of essential firepower, transportation, and communications capabilities. When these conditions exist, the combat effectiveness of the item, the unit, or the organization is lost; and the responsible commander is un-

able to perform his assigned mission effectively. An inventory management system that is responsive to customer requirements must include a well-managed maintenance program.

8-2. Relationship of Maintenance Management to Inventory Management

a. Inventory management, as explained in chapter 2, encompasses all areas of logistics. One of the goals of effective inventory management is to provide required customer support services at a minimal cost to the Government. In conjunction with this goal the inventory manager is responsible for insuring that the interrelated functional responsibilities of the various logistical areas are properly coordinated and controlled. These interfaces and relationships are prominently evident between the various logistics areas; but the relationships with which the inventory manager is most concerned, insofar as his supplying required assets to customers, are those involving the logistics areas of maintenance and procurement.

b. One of the mission elements of inventory management is to determine materiel requirements for Army Forces and to obtain the serviceable assets required. These assets are acquired in two ways—by new procurement and by the depot maintenance program. Maintenance management, like procurement, is a mission element of inventory management; and the status of the depot maintenance program is greatly affected by the decision of the inventory manager as to whether he will procure new equipment or perform depot maintenance on existing equipment. Several factors are considered in the decision-making process. Among these factors are the following:

(1) Procurement leadtime requirements as compared with overhaul in-process time.

(2) Original purchase price as compared with overhaul costs (including considerations such as projected life expectancy of both the new and the overhauled item).

(3) Urgency-of-need considerations and the most logical and economical means of satisfying these needs.

(4) Availability of funds as they relate to total materiel requirements.

(5) Economic repair policies.

(6) Current Army Master Data File (AMDF) catalog price as compared with overhaul cost.

c. When factors such as limited funds, urgency-of-need, and reduced procurement leadtime are prime considerations in the acquisition of assets, the inventory manager relies heavily upon the depot maintenance program to furnish the items required. In addition, the depot maintenance program is one of the principal means by which the inventory manager maintains a required stockage level; and in many instances, it is the most effective means of insuring that materiel is available on a timely basis. By means of the maintenance program, leadtimes are reduced, funding requirements are lowered, and program coordination and control as required by inventory managers are enhanced.

8-3. Maintenance Principles and Concepts

Maintenance principles and concepts delineate in broad terms the policies by which maintenance operations are governed. They designate who is to perform maintenance and how, when and where it will be performed; and they apply throughout item life-cycle management—from the earliest design phases of development through the disposal phase. Except for the function of requirements determination, the inventory manager is not directly engaged in the maintenance process. Because of his overall responsibility for managing the logistics program, however—being certain that the right item is at the right place at the right time—it is essential that inventory managers possess a general understanding of the concepts and principles that govern maintenance operations. This knowledge is necessary to the performance of a thorough analysis of the overall logistics function, an understanding as to where responsibilities for materiel maintenance management lie, a determination of the capabilities and limitations of maintenance logistical support, and an understanding of required interrelationships with the Army in the field.

a. *Maintenance Principles.* The basic principles of maintenance which are of interest to the inventory manager are:

(1) When maintenance is accomplished or planned, due consideration must be given to economy as it applies to pertinent resources.

(2) Continuous command emphasis must be placed on the prompt evacuation of reparable, un-serviceable end items and components to direct support, general support, and depot maintenance facilities as appropriate. This emphasis is necessary to be certain that maintenance contributions to the

materiel readiness program are made on a timely basis.

(3) Ordinarily, Table of Organization and Equipment (TOE) units will not be designated to perform as a primary mission more than one category of maintenance—direct support maintenance, for example. Specific exceptions, however, may be authorized by Headquarters, DA. These exceptions might involve special assignment, low-density equipment, and complex weapons systems; and they may require that a TOE unit perform more than one category of maintenance—direct support and general support, for example.

(4) Normally, Table of Distribution—Allowances (TDA) fixed maintenance facilities at installations are assigned combined direct and general support (DS/GS) maintenance missions in support of units permanently located on the installation or satellited thereon. Items repaired may be either returned to the user or returned to the local supply system.

(5) Maintenance is accomplished in accordance with the applicable Maintenance Allocation Chart that is designed for each item of equipment. This chart prescribes the specific scope of maintenance authorized to be performed at each category of maintenance and engineered performance standards established for each maintenance task.

b. *Maintenance Concepts.* Basic maintenance concepts which are of interest to the inventory manager are as follows:

(1) *Repair parts supply.* Repair parts allowances and initial guide quantities to support maintenance missions are shown in appropriate technical manuals entitled "Repair Parts and Special Tool Lists" (RPSTL). Direct support TOE maintenance activities furnish repair parts to units they support; but normally, general support TOE maintenance units are not assigned a repair parts distribution mission. Repair parts are assigned to general support units primarily to support the assigned maintenance mission. In all maintenance categories, controlled cannibalization, when authorized, is used as a source of supply for specific repair parts and accessories.

(2) *Equipment records.* Accurate, required records of data generated by The Army Maintenance Management System (TAMMS) (TM 38-758) must be kept by commanders at each appropriate command level.

(3) *Maintenance Assistance and Instruction Team (MAIT).* The MAIT program augments the commanders capability for providing maintenance and associated logistics assistance and instruction (A&I) to organic, attached, and supported units. This program is designed to promote maintenance awareness at all levels and provides a means whereby technical expertise, not otherwise available within

the organic resources of a unit or a supporting direct support unit, could be furnished individual unit commanders. This assistance helps commanders identify and solve problems which contribute to the inability of their units to meet readiness standards. Assistance and instruction teams stress the importance of proper care and operation of Army equipment and emphasize practical application of maintenance techniques and procedures for the individual soldier.

(4) *Contract maintenance.* Contract maintenance supplements the in-house maintenance capability of the Army. Its principal application is in support of nontactical activities. Contract maintenance is not used when it precludes or jeopardizes the Army's attaining and sustaining the military organic capability necessary to support mission-essential equipment.

(5) *Maintenance float.* A maintenance float consisting of end items or major components of mission-essential, maintenance-significant equipment is authorized for stockage by direct support, general support, and depot maintenance activities as applicable. Float items are used to replace unserviceable, mission-essential equipment (discussed in more detail in chapter 7).

(6) *Equipment serviceability criteria.* Equipment serviceability criteria are the means by which commanders at all levels evaluate the serviceability status of equipment authorized and issued to units under their command. These criteria use a color code to categorize equipment into one of three conditions of combat serviceability: green, for operational with full reliability; amber, for operational with limited reliability; and red, for nonoperational or unacceptable reliability. Recently, system and equipment ratings have been changed to "Ready"—formerly green and amber, "Reduced Materiel Condition (RMC)" for specific end items and "Not Ready" formerly red.

(7) *Maintenance standards.* Maintenance standards must be established for each major item of equipment. These standards specify the minimum condition to which an item must be restored to insure satisfactory performance for a specified period of service. Repair, overhaul, rebuild, or some other maintenance function are the means by which the restoration is effected.

(8) *Maintenance expenditure limits.* Maintenance or repair expenditure limits are the means by which the economical reparability status of Army materiel is determined. Initially they are included in the maintenance support plan for the items; and they are predicated upon maximum one-time repair costs and the projected or established life expectancy of the item.

(9) *Modifications.* Item modifications must be authorized by DA Modification Work Orders (DAMWO). The DAMWO is initiated by the agency assigned the logistical responsibility for an item, and

it consists of authentic and uniform instructions for the alteration of materiel.

(10) *Reporting.* Each level of command, as appropriate, is required to report maintenance accomplishments and to submit these reports in accordance with TAMMS and other established policies and criteria.

(11) *Maintenance management.* Managing the maintenance function, using approved management techniques, is a responsibility of commanders at all levels. It includes the task of determining the scope of resource requirements and the judicious use of resources to accomplish maintenance objectives.

8-4. Maintenance Categories

a. Effective management and operation of the Army maintenance system depends upon a well-knit, smoothly functioning organization that ranges from depots, where the highest level of complex repair and overhaul operations are performed, to units and organizations, where relatively simple preventive maintenance operations are performed. Mission responsibilities, mobility requirements, and organic capabilities are considerations involved in designing the type of organization to which specific maintenance functions are assigned.

b. To facilitate the assignment of maintenance functions, the Department of the Army has classified maintenance functions into four categories—organization, direct support, general support, and depot. The maintenance support planner uses these maintenance categories as aids in relating maintenance operations to other military operations; providing bases for identifying organizations that perform specific maintenance operations; defining the degree of maintenance which can be performed by a unit, an organization, or a maintenance facility; and distribution resources in accordance with requirements. The specific mission responsibilities assigned to each specific category of maintenance are as follows:

(1) *Organizational maintenance.* Organizational maintenance is the responsibility of the unit commander. It is the means by which equipment is maintained at the required level of operational readiness. It includes both preventive maintenance services and the organizational level repairs authorized in appropriate technical publications.

(2) *Direct Support (DS) maintenance.* DS maintenance pertains to the maintenance support which TOE and TDA maintenance activities provide to designated units within a specified area. Maintenance is performed on a repair-and-return-to-user basis, and organizational maintenance repair parts are supplied by TOE, DS maintenance units to using units. In addition, DA maintenance activities are assigned maintenance float, mission-essential, maintenance-significant items (for supported orga-

nizations) which are exchanged for unserviceable parts, assemblies, components, or end items.

(3) *General Support (GS) maintenance.* General support maintenance is, normally, assigned to and performed by designated TOE and TDA maintenance units or activities in support of the Army area supply system. Except when assigned a direct support mission, GS maintenance does not have a repair parts distribution function. General support maintenance units receive equipment for repair and overhaul from direct support units, collection points, supply units, and other activities for which they are assigned maintenance support responsibilities. It constitutes the principal maintenance overhaul capability available to the field Army commander.

(4) *Depot maintenance.* Normally, depot maintenance is assigned to and performed by either des-

ignated TDA industrial-type organic activities or commercial contractors. The primary purpose of depot maintenance is to augment stocks of serviceable assets by repairing, overhauling, and rebuilding unserviceable ones which require maintenance that is beyond the capability of general support maintenance activities. In some instances, however, items undergoing depot maintenance are returned to the user—as is the case when certain types of vessels undergo cyclical overhaul. Depot maintenance is usually accomplished in fixed shops and facilities that are Government owned and operated, Government owned and contractor operated, or contractor owned and operated. Depot maintenance normally encompasses one or more of the following work accomplishment functions: fabrication/manufacture and reclamation/disassemble.

Section II. RESPONSIBILITIES FOR ARMY MAINTENANCE MANAGEMENT

8-5. Major Command Relationships

a. Within the Department of Army, staff responsibility for the logistics function and, therefore, inventory management and maintenance function, is assigned to the Deputy Chief of Staff for Logistics (DCSLOG). The missions of other staff elements, however, have a great amount of influence on the maintenance effort. For a clear perspective of the maintenance management function and the responsibilities involved in its accomplishment, it is necessary to recognize these influences and the intrinsic command relationships which they generate.

b. The term “maintenance management” is often envisioned as pertaining solely to the performance of a work operation. This viewpoint, however, is restrictive in nature and is not considered to be completely valid. Maintenance is one of the many actions involved in item life-cycle management. Before maintenance can actually be performed, determinations are made as to the type of warfare to be waged, the kind of equipment and materiel required to support the combat effort, ways and means of acquiring materiel, and both the types of skills and the qualifications of personnel required to operate and to maintain materiel assets. Three major commands and the Military Personnel Center are responsible for making these determinations. The Military Personnel Center is responsible for providing both the officers and the enlisted men required for Army operations: the US Army Training and Doctrine Command (TRADOC), for establishing doctrine as to how the Army will fight and what kind of equipment is required; the US Army Materiel Development and Readiness Command (DARCOM), for providing and maintaining the materiel required to support Army operations; and TRADOC, for accomplishing the training mission of the Army. In addition, perti-

nent communications media must be established and facilities must be made available. In the area of maintenance management, these command functions are interrelated and interdependent. To plan and to coordinate a maintenance system which culminates in the effective performance of required operations necessitates that these interrelated functions be formed into a well-organized, integrated system which insures the timely availability of resources and their maximum utilization.

8-6. Department of the Army Responsibilities for Maintenance Management

The objectives and operations of the Army maintenance management program are profoundly affected by national policy-level decisions made by the President and Congress and transmitted through channels to the Department of Defense and then to the Department of the Army. Specific maintenance policies for the Department of the Army, however, are formulated under the direction of the Secretary of the Army. These policies are discussed in detail in FM 750-80. A brief review of those of primary concern to the inventory manager follows.

8-7. Deputy Chief of Staff for Logistics (DCSLOG)

a. Within the Office of the DCSLOG, the Directorate for Supply and Maintenance acts for the DCSLOG in matters pertaining to the Army worldwide supply and maintenance system. Specific functions of this responsibility are assigned to the Supply Division and Maintenance Division within the Directorate of Supply and Maintenance.

b. The Maintenance Division is responsible for developing and promulgating Department of Army

policy applicable to the maintenance and to readiness of Army materiel. In conjunction with this responsibility the director coordinates and exercises General Staff supervision over the Army Maintenance System. This staff supervision includes coordinating and supervision materiel readiness functions related to programs which support international logistics, programming and budgeting actions, mobilization planning for maintenance, and career field programs pertinent to maintenance management.

c. The Supply Division exercises General Staff supervision over policies and procedures which govern the supply distribution system and requirements determination for major items, secondary items, and repair parts.

8-8. US Army Materiel Development and Readiness Command (DARCOM)

The DARCOM has overall responsibility for managing the materiel and related services required by the Army. This responsibility includes maintenance management as it applies to P7M (Depot Materiel Maintenance Support Activities); and in executing this responsibility, the Commander of DARCOM reports to and receives instructions from the Chief of Staff, US Army. Because of the interdependent relationships which exists between logistics elements, each directorate within DARCOM has an interest in the management of the maintenance function. However, the Director for Materiel Management is the most directly involved. Its primary missions are:

- (1) To direct and control budget programs for Operations and Maintenance, Army (OMA) Program 7, P7M (Maintenance) and P7S (Supply).

- (2) To establish policy and provide guidance for materiel requirements determination for acquisition, overhaul, retention, replacement, and disposal.

- (3) Preparation of the OPS Form Exhibits.

- (4) Establishing maintenance float and repair parts replacement factors.

- (5) Establish policy and provide guidance for depot maintenance mobilization planning.

8-9. DARCOM Major Subordinate Commands

a. Within the DARCOM complex are five major subordinate commands responsible for materiel readiness. These materiel readiness commands (MRC's) are responsible for either the total or the integrated management of specific commodities or materiel groupings. This responsibility includes depot maintenance management. Among the maintenance responsibilities assigned to these commands are the following: maintenance support planning, to include the provisioning of initial repair parts, test equipment, and materials handling equipment; the preparation of equipment publications; technical as-

sistance requirements; national maintenance contracting; requirements computation; and depot maintenance program direction.

b. In addition to an NICP, a national maintenance point (NMP) is established within each materiel readiness command. The NMP (or Director of Maintenance) functions as a coequal entity with the NICP. Actually, the NMP is the key to the success of the maintenance management program of DARCOM. Even though its activities are influenced to a considerable degree by the requirements of the NICP, the NMP has both maintenance and technical responsibility, worldwide, for a specific commodity or group of commodities. In addition, it is responsible for providing to the Army depots specific working-level direction relative to the maintenance support required for the commodity group. The major functions of the NMP are in the areas of maintenance engineering, support planning, publications, and technical assistance; therefore, the responsibilities of the NMP for a particular item or commodity continue throughout the life cycle of the item. The NMP and the NICP, because of the interrelationship of their missions, must closely coordinate their maintenance functions. This coordination is necessary to be certain that the technical and administrative resources required to meet the needs of the equipment user are available and programed properly.

c. Currently, there are 19 depots and depot activities within the DARCOM complex, including 2 depots in Germany. These depots function under the control of the Commanding General, US Army Depot System Command (DESCOM), one of the major subordinate commands of DARCOM. Generally, the maintenance missions assigned to these depots encompass the following functions: fabrication/manufacture and reclamation/disassemble. A depot may be assigned maintenance workloads relative to one or more commodities. The present trend for workloading, however, is based upon the "Prime Depot Concept." Under this concept, each National Stock Numbered item programed for depot maintenance is assigned to a prime depot which will usually handle all of the depot maintenance on that item until its capability is reached. If the depot maintenance requirements exceed the prime depot's capability, a secondary and possibly a tertiary depot may be assigned to handle the program. The Army depots assigned a depot maintenance mission are as follows:

- (1) Anniston Army Depot.

- (2) Corpus Christi Army Depot.

- (3) Letterkenny Army Depot.

- (4) Lexington-Blue Grass Army Depot Activity.

- (5) Mainz Army Depot.

- (6) New Cumberland Army Depot (AOD).

- (7) Ober Ramstad Army Depot.
- (8) Pueblo Army Depot Activity.
- (9) Red River Army Depot (AOD).
- (10) Sacramento Army Depot.
- (11) Seneca Army Depot.
- (12) Sierre Army Depot.
- (13) Tobyhanna Army Depot.
- (14) Tooele Army Depot.

d. In addition to depots, other activities such as arsenals and plants are assigned depot maintenance missions. A considerable portion of the maintenance mission at these activities pertains to demilitarization and surveillance functions. Among the activities of this category are Rock Island Arsenal, Joliet Army Ammunition Plant, Iowa Army Ammunition Plant, Pine Bluff Arsenal, and Rocky Mountain Arsenal.

e. Command and control authority over the DARCOM depots has been assigned to HQ DESCOM. When DESCOM was created, it absorbed the mission and resources of the Major Item Data Agency (MIDA). The mission includes responsibility for managing and executing the Worldwide Asset Data Evaluation Program and performing reconciliation and evaluation for Army Workload Assets; assisting in managing Procurement Appropriation (PA) major items and selected secondary items by operating and maintaining the Army logistics data base for PA items; managing, allocating, and controlling funds to operate and maintain the depot system. HQ DESCOM is responsible for depot maintenance mobilization planning and workload distribution.

Section III. PLANS, PROGRAMS, BUDGETS, AND FUNDS FOR DEPOT MAINTENANCE

8-10. Relationship of Plans, Programs, and Budgets

Plans, programs, budgets, and funds provide the framework by which concepts and mission functions evolve into operations. They are inextricably linked; and together they provide the means by which strategic, tactical, and organizational concepts; technological forecasts; and intelligence estimates are developed, examined, and adopted. Plans are broad, and generally they project objectives up to 20 years into the future. Programs evolve from plans, and usually they provide detailed data for the first 5 years of the planning cycle and general data for the succeeding 3 years. Budgets, normally, are prepared in detail and reflect the resources required to support the program during the budget year. A detailed discussion of DOD and DA plans and programs is given in chapter 4. The application of these programs to maintenance management is presented in detail in FM 750-80, Logistics, Maintenance Management. It is essential that the inventory manager understand

the maintenance management application and the funding concepts applicable to them.

8-11. Army Five-Year Defense Program

Within the Army Program System, the Army Five-Year Defense Program (FYDP) has the greatest significance to the depot maintenance program. The FYDP forecasts for each year of the 5-year period the description, the quantity, and the cost of items required to support the Army Force structure. Initial requests and justifications for program operating funds are based on this program.

8-12. Exhibit OPS 25 Forms

The Exhibit OPS 25 Forms are major documents used in developing the depot maintenance portion of the Army FYDP. The US Army Depot System Command is responsible for their development. The OPS 25 Forms cover a period of 5 years and show the present supply status of major items of materiel and the proposed use of P7M funds and other resources to satisfy requirements.

Section IV. DEVELOPING AND EXECUTING THE DEPOT MAINTENANCE PROGRAM

8-13. Determining Requirement

a. As discussed in Chapter 5 one of the primary mission responsibilities of the inventory manager is to determine what portion of a total asset requirement will be satisfied by means of the depot maintenance program.

b. To determine asset requirements for the depot maintenance program, the inventory manager must ascertain the number of standard assets available, worldwide, for each item and must relate this number to the gross requirements for the item. This de-

termination is accomplished periodically by means of—

- (1) The Army Materiel Plan for major items.
- (2) Item Management Plan (Supply Control Studies).

These studies include an analysis of stock status reports submitted by depots, overseas commanders, major Army CONUS commanders, and other reporting agencies. In conjunction with the review and analysis of these studies, the NICP considers factors such as combat losses, real or anticipated; losses in-

curred during training routines; prescribed stockage levels; materiel in transit from one place to another; availability of substitute items; Class IV (special project) requirements; recurring and nonrecurring demands for components and accessories as reflected on depot maintenance parts requirements list (DMPRL); and float requirements. Included in the data contained in the Army Materiel Plan and Supply Control Studies are the total number of assets in the inventory. In addition, these assets are identified as being serviceable or unserviceable but economically reparable. Assets considered as prime candidates for the depot maintenance program are the unserviceable ones classified under condition reservation codes "F" or "M." Code "F" pertains to unserviceable but economically reparable materiel which is in the possession of the using activity. Code "M" pertains to unserviceable but economically reparable materiel which has been submitted to a depot maintenance facility for processing and identified as such on the inventory control records of the using activity.

8-14. Planning the Target-Year Workload

a. The planning cycle as it pertains to the target-year workload for P7M actually begins 14 months prior to the year the program is to be executed. The first stage in this planning cycle is the designation of requirements to be satisfied by the depot maintenance program. Generally, worksheets are used to transmit requirements data from the NICP to the NMP. These worksheets identify by nomenclature and National Stock Number those economically reparable assets which comprise the depot maintenance program. In addition, the worksheet contains overhaul costs, economic repair limitations in terms of years and dollar percentages, customers, priorities, and any other information required to initiate programing and scheduling actions for Budget Program P7M. Also, these data and information are used to complete Procurement/Work Directives (PWD). A Procurement/Work Directive is prepared for each item for which an overhaul program for a specific depot is planned.

b. National maintenance points are responsible for furnishing PWD's to DESCOM where data from the PWD is developed into individual Depot Master Plans which are forwarded to the applicable depot or maintenance activity. The plans also show program delivery dates recommended by the item manager. Depot maintenance facilities analyze the plan, annotate it to reflect acceptance or recommended adjustments to program requirements, and return the marked up plan to DESCOM. From the marked up plans, DESCOM prepares a tentative Depot Maintenance Plan.

c. In conjunction with this review, depot markups of the Master Plan are analyzed, maintenance requirements are updated, and workload projects are adjusted. As a result of the actions, a firm depot maintenance program is established and provided to NICP representatives—both supply and maintenance. Based on this firm program, inventory managers amend the initial PWD's and submit them to DESCOM. These PWD's constitute the basic asset requirements to be provided through BP 7N. These requirements are adjusted continuously as dictated by changes in program elements such as funding guidance, force requirements, asset availability, and performance capabilities.

d. Work Authorizations (WA's) are prepared by DESCOM and are based on data shown on the amended PWD. They contain specific program information such as the work to be performed, the authority to perform it, the applicable technical standards, the number of assets on hand, and the support materiel required to accomplish the program. For Army Industrial Funded activities, the WA is also a funding document. Actually, a WA is an agreement by one party to perform work for another in accordance with stated specifications. In this sense, it is very much like a contract. DESCOM issues work authorizations to the performing maintenance activities. These activities either accept the program as it is shown or mark up the WA to show adjustments required to bring the program within the capability limits of the activity. Depot maintenance activities are allowed to accomplish only those programs for which Work Authorizations authenticated and issued by DESCOM are received.

8-15. Programing and Scheduling Depot Maintenance

a. *Development of Depot Maintenance Requirements.*

(1) The process for developing depot maintenance requirements is presented in FM 750-80. The materiel readiness command develops the gross AMP, reviews the gross maintenance requirements with regard to their supportability, and forwards the requirements to DESCOM for further analysis. DESCOM evaluates the organic depot maintenance requirements. The appropriate materiel readiness command also performs economic analyses to determine the means of accomplishing the maintenance workload by making comparisons and trade-offs among alternative sources considering cost, schedule, and performance.

(2) The DA level depot maintenance Budget Manpower Guidance (BMG) utilized in the preparation of the depot maintenance requirements is promulgated by DA DCSLOG to HQ DARCOM. DARCOM utilizes this guidance to develop the net depot

maintenance requirements, which are forwarded then to the appropriate materiel readiness command for finalization of the requirements data portion of the AMP.

b. Detailed Information Flow of the Major Item Depot Maintenance Process.

(1) As indicated in the previous section, the planning process for depot maintenance begins with the input of the gross requirements from the AMP. The materiel readiness commands develop program requirements from the gross materiel requirements within the existing funding constraints, and transmit the planned program via BT cards (automated maintenance data transmission information) to DESCOM which develops the depot capacity and capability. The BT-series cards present detailed statements of depot requirements for the coming fiscal year.

(2) DESCOM runs the input from the materiel readiness commands against the depot capacity and capability data and workloads the depot for both the planning out years (magnetic tape) and the execution year (BT-series cards). The depots then accept, reject, or mark up the cards (programs) and return them to DESCOM. The materiel readiness commands are notified by DESCOM of the latest depot workload. DESLOG and DARCOM representatives meet to review/revise maintenance plans. The basic input to this meeting is the set of initial planning estimates of materiel requirements to be satisfied by depot maintenance. At this meeting, representatives measure the tentative depot maintenance plans against original materiel requirements; changes to those requirements, financial guidelines, and procurement plans. The result of these reviews is a refinement of the 5-year depot maintenance planning base.

c. The Depot Workloading Process.

(1) The detailed procedures represent the depot workloading process performed in the maintenance planning phase. The preparation by the materiel readiness commands of the BT-series cards which are forwarded to DESCOM, generates workloads for the depots. As indicated in the discussion of the detailed flow chart, both the materiel readiness commands and DESCOM receive the BMG financial guidance that is generated as a result of the DOD/DA budgetary planning process. The materiel readiness commands prepare their maintenance programs to be in agreement with this financial guidance. In addition, DESCOM also reviews the programs to see that they are in agreement with the BMG. If any deviations are found, the BT cards are returned to the materiel readiness commands for correction.

(2) As a part of the planning process for depot maintenance, prime and secondary depots will be designated by DESCOM and DARCOM. As used here, "primary" refers to the most cost-effective depot

facility and "secondary" refers to the next most cost-effective depot facility. These designations are made on the basis of lowest time/overhaul cost for the system and other significant factors.

(3) DESCOM, using the depot maintenance requirements, the priorities, the designations of the primary and secondary depots, and known constraints on manpower and funding, prepares the depot workloads that are used as input to the Exhibit OPS 25 Forms.

(4) Depot workloading for planning years is accomplished by using the constraints of the manpower, equipment, and facility limitations. There is an implicit cost constraint, since the only programs used to develop the workloads are those which are in accordance with the funding constraints of the BMG. The primary depot is loaded first and then the secondary depot. DESCOM assumes acceptance of planning workloads.

(5) For the execution year, the workload is generated by DESCOM. Each February, prior to the execution year, DESCOM will transmit the execution year workload on BT-series cards for initial action. Once the depot workloads for execution year are generated, the depots can accept, reject, or mark up. If a depot accepts the program, DESCOM is so notified. When a depot rejects its portion of a program, DESCOM is informed of the rejection and the reason for it. DESCOM also informs the materiel readiness command of programs which cannot be completed, (e.g., rejects) so the command can reevaluate its requirements.

(6) A third possible result of the depot's review of the execution maintenance program is a markup. The only portion of the plan the depot is permitted to modify is the unit maintenance funded cost. The proposed cost is submitted to DESCOM. Once a price has been agreed upon by the depot and DESCOM, the price is "fixed" and cannot be changed for the life of that program, unless the customer changes the maintenance specifications or compresses the production quantity 3 or more months. If either of these exceptions occur, the depot may negotiate a "new" fixed price with DESCOM.

d. Budgeting.

(1) At the DA level, the depot maintenance plans are combined with the procurement plans (AMP) as a part of the total Army budget preparation process. At the same time the DOD/DA review of the depot maintenance program plans for the budget execution year is occurring, these plans are undergoing detailed refinement within DARCOM.

(2) Once Congress approves the budget, DA reviews the budget and manpower guidance, forwards the guidance to DARCOM who, in turn, notifies

the materiel readiness commands and DESCOM of changes in the planned program.

(a) With the refined program input from the MRC's, DESCOM reworkloads the depots and sends a magnetic tape of planned program to the depots and the materiel readiness commands. The depots refine their programs in the DESCOM Depot Maintenance Data Bank.

(b) The DOD/DA path of the apportionment planning cycle begins when the Congress approves the DOD budget. Based on the congressional appropriations, DOD makes apportionment decisions and forwards them to DA. DA and DARCOM, in turn, make more detailed apportionment decisions which result in the allocation of the Army budget to the various programs. The maintenance programs are refined by the materiel readiness commands in accordance with the funding constraints.

(c) A final review of the depot maintenance plans for the coming year is made by DA and DARCOM. Any changes needed in the plans to bring them into line with the apportionment decisions are made, and the materiel readiness commands are informed of the changes. The materiel readiness commands, in turn, update the DMDDB to reflect the latest program revisions. Once again DESCOM workloads the depots, and the depots reschedule their work in light of these changes.

8-16. Parts Forecasting

a. Parts forecasting is one of the most important functions of the depot maintenance management effort. Determining end item overhaul requirements is relatively predictable; but accurately forecasting repair parts requirements is difficult and often impossible, unless a complete teardown and inspection of the item to be overhauled is performed. The age of an item, the environment in which it is used, its operator, and a number of other variables combined to make unique the usage history of each item entering the depot maintenance shops.

b. The estimated number of repair parts, components, and accessories required for an overhaul program is based on recurring and nonrecurring demands. The demands are established as Depot Maintenance Requirements Levels (DMRL). The NMP of each materiel readiness command is responsible for consolidating specific item levels reported by the individual depot or overhaul facility and transposing resulting totals into consumption rates. These rates are transmitted to the inventory manager who, by applying them to the applicable end item, computes worldwide repair parts requirements.

c. Procurement action for repair parts required to support maintenance programs for a budget year is

initiated during the current year. These requirements are based upon the funded part of the BP7M Program. Procurement is initiated far enough in advance of the program year to allow for procurement lead-time and other related time-consuming actions; and to insure that parts are delivered to the performing activity at least 90 days before the repair or overhaul program is scheduled into the shop. As a minimum, quantities delivered must be large enough to support maintenance schedules for at least one quarter. Procurement action is the responsibility of the item manager and includes all repair parts required, regardless of which NICP or DOD management activity has inventory control of the required repair part. Repair parts procured or acquired for worldwide maintenance programs are pre-positioned, insofar as practical, at a storage location close to the depot maintenance facility at which maintenance will be performed. Should the supply manager be unable to obtain the number of repair parts required, the planned overhaul quantity of end items reflected on the PWD is reduced proportionately. DESCOM accepts PWD's with the assumption that repair parts will be available when required. This assumption is based upon the DA policy which states that maintenance will not be programed unless parts are either on hand or ordered in time to be certain that they are available at depot shops or contractor plants in time to satisfy production schedules.

8-17. Generating Assets

a. Comparable to the value of repair parts to an overhaul program is the availability of unserviceable assets. Without either repair parts or unserviceables, the program cannot be accomplished. In recognition of this requirement, unserviceable asset turn-in schedules are established. These schedules, or turn-in forecasts as they are sometimes called, are reviewed by item managers, DESCOM, and DARCOM 90 days prior to the start of the execution quarter. As a result of this review, Procurement/Work Directives and Work Authorizations are updated.

b. When it appears that unserviceable assets will not generate in accordance with unserviceable distribution schedules, the commander of the applicable depot maintenance activity is responsible for making this status known to the item manager. The item manager, in turn, is responsible for taking whatever actions are necessary to expedite the turn-in of unserviceable repairable assets. When the user fails to react to the expediting actions, the item manager refers the problem to Headquarters, DARCOM for disposition.

c. The NICP's, under the direction of DARCOM, have established automatic-return time standards for intensively managed items and some others that either require cyclical overhaul or have been classi-

fied as unserviceable but economically repairable. Instructions for the automatic return of these items to designated depot maintenance facilities in CONUS are published in the ARIL provided by CDA.

Section V. REPORTING DEPOT MAINTENANCE ACCOMPLISHMENT

8-18. Management Data

a. The term "management data" as used in this discussion pertains to the information which a system generates during day-to-day operations. This information is reflected in reports of various types and is used by inventory managers and maintenance managers to determine program performance levels.

b. Management data serve many purposes. When made available on a timely basis, they are indispensable to effective life-cycle management of systems and equipment. These data are required to conceive, define, develop, test, and acquire materiel; and, in addition, to maintain and support it properly. Too, they provide inventory managers and maintenance managers with the information required to evaluate the readiness-availability status of equipment, the adequacy of resources, and the cost-effectiveness of maintenance operations. By carefully analyzing management data, managers are able to isolate problem areas and to make adjustments necessary for improvement.

c. The Army Maintenance Management System (TAMMS) (TM 38-750, C1 and C2), which is discussed in detail in FM 750-80, Logistics Maintenance Management, is the prime source of data used in maintenance management operations. Two of the principal reports generated by TAMMS, the Equipment Improvement Recommendation (EIR) and the Modification Work Order (MWO), influence the requirements computations of the inventory manager and help to determine the workload of depot maintenance facilities. In many instances, depending upon the urgency-of-need, units may not be able to use equipment until required improvements or modifications have been made. When these conditions exist, the item manager must ascertain whether the time frame within which equipment is required is compatible

with the time frame within which it can be made available. On the basis of this analysis, he determines whether new procurement or depot maintenance is needed to satisfy requirements on a timely basis. Other factors, such as the capabilities of organic facilities, are also considered. In addition to the EIR and the MWO, other reports such as the Program Status Report, Capability Study, and the Army Equipment Distribution Plan play prominent roles in the mission functions of the inventory manager and the maintenance manager. How these reports influence mission functions is explained in the paragraphs that follow.

8-19. Program Status Report

A program status report (PSR) is a current account of the transactions and status of the depot maintenance programs assigned to a performing activity. Each maintenance activity to which work authorizations have been issued is required to furnish to DESCOM each day, or as events of significance happen, a report on official authorized programs. Cost information, except that pertaining to national contracts, is reported as of the 15th day and the last day of each month. National contract cost information is reported only on the last day of each month. The report is by line item and contains production data and cost data as appropriate. The production data reflects the asset position of the item in terms of authorized quantities, planned quantities, completions, schedule information, and the number of direct labor man-hours expended. The cost data reflects total planned program cost, costs incurred to date by cost element, work-in-process costs, acquisition value of completed quantities, funded costs of onhand and scheduled turn-in quantities, and direct labor man-hour costs.

CHAPTER 9

MANAGEMENT OF EXCESS AND SURPLUS PROPERTY

Section I. THE DEFENSE MATERIEL UTILIZATION PROGRAM

9-1. General

a. Logistics managers must constantly face the task of balancing supply and demand. This task becomes more critical in times of war as enemy actions affect requirements for most items of supply in ways that are difficult to predict. Even if it were possible to predict the precise time a war would end, there would probably be excesses of some items of supply due to such factors as obsolescence, miscalculations, and overly conservative safety levels. Despite the inevitability of excesses, good management practices can reduce the magnitude and increase the economic return through utilization or disposal actions.

b. A clear understanding of the distinction between excess and surplus property is essential to this discussion. Excess property is the quantity of property in possession of any component of the Department of Defense (DOD) which exceeds the quantity required or authorized for retention by that component. Surplus property is any excess property not required for the needs and for the discharge of the responsibilities of all Federal agencies, including the DOD, as determined by the General Services Administration (GSA).

9-2. Objectives

Personal property (including scrap) will be disposed of in a manner which will insure maximum Federal utilization through withdrawal or transfer; permit authorized donation to satisfy valid requirements; obtain optimum monetary return to the Government for property sold; and minimize the need for abandonment or destruction. The procedures, codes, and uniform formats of the Military Standard Data Systems, Military Standard Requisitioning and Issue Procedures (MILSTRIP), Military Standard Transaction Reporting and Accounting Procedures (MILSTRAP), etc., will be used to the maximum extent possible in all property disposal transactions. Precious metals bearing scrap and end items containing precious metals will be disposed of in a manner which will insure cost-effective disposition and recovery of precious metals when economically feasible under the Precious Metals Recovery Program.

a. As a general policy, property once advertised for sale will not be withdrawn. Exceptions to this general statement will be permitted only when property involved is required in support of approved Government programs, and the action determined to be in the best interest of the Government. Heads of DOD components will insure that withdrawal authority is stringently controlled and applied. (This policy is predicated upon the workload and adverse public relations, up to and including court cases, which result unless careful control of withdrawals is effected.)

b. To achieve these objectives, disposal programs should be integrated with other logistics programs. Research and development, inventory management, distribution management, maintenance management, and procurement and production management all have a direct relationship to disposal programs. In most instances, introduction of new principal items of materiel will result in similar items being declared obsolete. Planning for the gradual phaseout of materiel being replaced is essential to preclude large quantities of excess.

9-3. Authority and Responsibilities

a. The Federal Property and Administrative Services Act of 1949, as amended, (Act of 30 June 1949. 63 Stat. 388, 40 U.S.C. 471) assigned responsibility for the overall supervision and direction over the disposition of excess and surplus property to the Administrator of General Services. The act further assigned the responsibility for supervision and direction over the disposition of DOD foreign excess property to the Secretary of Defense. The Administrator of General Services has delegated to the Secretary of Defense the responsibility for the disposition of excess and surplus property generated by DOD.

b. The Secretary of Defense has assigned responsibility to the Director of the Defense Logistics Agency (DLA) for the overall worldwide management of the Defense Personal Property Disposal Program in the role of integrated program manager. Accordingly, HQ DLA, is responsible for the development of policies relating to this program and

the development of systems, techniques, and procedures as may be appropriate. In its role of integrated program manager, DLA will:

(1) Promote maximum utilization of excess, surplus, and foreign excess personal property.

(2) Establish/disestablish defense personal property disposal organizations under the control of DLA and coordinate such action with the appropriate military services and other DOD components when it will affect the disposal support currently being provided their activities. Except when diplomatic considerations do not permit it in overseas areas, this formal coordination will be accomplished in sufficient time for the military Service or other DOD components affected to properly program and require resources in accordance with prescribed procedures. Coordinate such establishment/disestablishment with the Assistant Secretary of Defense (Manpower Reserve, Affairs, and Logistics).

(3) Administer the Defense Donable Surplus Personal Property Program as it applies to approved service educational activities. This includes such actions as prescribing procedures, development of donation agreements, and processing requests to higher authority for deviation from formal agreements.

(4) Insure maximum compatibility between documentation procedures, codes, and formats used in property disposal systems and the military standard systems.

(5) For sales involving reimbursement to owning activities and programs (e.g., Military Assistance Program (MAP), Coast Guard, exchange/sale, industrial fund scrap), review the relationship of sales proceeds to disposal expenses for the purpose of recommending to the Office of Assistant Secretary of Defense (OASD) (Comptroller) the percentage of proceeds to be used or other method to be used in establishing estimated expenses that will be deposited to the Deposit Fund Account in conjunction with processing this type of disposal property.

c. The Secretary of Defense has assigned the military services responsibility for the following:

(1) Provide assistance to the Director, DLA, upon request, in the resolution of mutual problems within the Defense Personal Property Disposal Program.

(2) Promote maximum utilization of excess, surplus, and foreign excess personal property.

(3) Provide support to tenated Defense Property Disposal Regional Offices and Defense Property Disposal Offices (DPDO); and their offsite branch, in consonance with applicable interservice support agreements. Except where diplomatic considerations do not permit it in an overseas area, the disestablishment of the host of one of these disposal elements will be formally coordinated with DLA in sufficient time for DLA to properly plan and program the ac-

complishment of the realignment of the disposal support which will occur as a result of disestablishment.

(4) Exercise authority in consonance with existing DOD policies to designate items as exchange/sale property to be conveyed to property disposal accounts.

(5) Identify items requiring demilitarization and, as applicable, accomplish demilitarization of those items which cannot be physically accepted by a DPDO in accordance with DOD policy.

d. To carry out its responsibilities in relation to excess and surplus personal property, DLA established the Defense Property Disposal Service (DPDS) as its primary field activity to perform program management and staff supervision of the Defense Personal Property Disposal Program, consisting of five Defense Property Disposal Regions (DPDR's) and assigned the DPDR's the DPDO's worldwide.

e. DOD generating precious metals bearing property and scrap and waste materiel will normally turn in all excess to their servicing DPDO. There may be times, however, when a generating activity desires and will be authorized by DLA to ship recovered precious metals, such as electrolytic of lake, spent recovery cartridges or sludge, etc., direct to a commercial contractor or to the DPDM-R.

9-4. Excess Declaration and Reporting

a. The logistics manager constantly faces the task of purging the inventory of stocks that are excess to current needs or foreseeable requirements. Realizing that it is costly to maintain an inventory larger than needed to support using units, supply managers at all levels must determine what portions of stock in long supply (that is, in excess of the quantity authorized or required to be on hand) can be economically retained for future use or, conversely, reported as excess. It should be emphasized that the supply manager is concerned with materiel in the possession of using units as well as stocks on hand in supply installations, particularly materiel that must be reported to the appropriate materiel management center overseas or national level inventory control point (ICP) within CONUS for disposition instructions when no longer needed by the user.

b. Management tools are available to the supply manager to assist in predicting excesses. For certain classes of supply, excesses can be predicted by an economic retention formula which shows at what period the cost of retaining an item is equal to the cost of disposing of it and reprocurring it at a later date. Retention costs include such elements as cost of storage space, care and preservation, cost of issue, transportation, deterioration, and obsolescence. In addi-

tion to cost factors, consideration should be given to future utility and essentiality of the item, the effect of retention on procurement of more modern materiel, and the capability of procurement and procurement leadtimes. Although the same elements are considered to varying degrees, a formalized economic retention formula is seldom used with high-value items but is normally associated with low-value items of materiel. The capital investment takes on added importance as the unit value of the item increases.

c. The excess declaration and reporting of automatic data processing equipment is governed by DOD 4160.19M, Defense ADPE Reutilization Manual.

9-5. Reporting Channels in the Continental United States

a. As a rule, excess property in the hands of units of CONUS installations is reported to the accountable officer serving that activity. Excess property of CONUS installations will be reported by the accountable officer to the appropriate ICP for disposition instructions. Excess property will be reported in accordance with procedures outlined in AR 725-50. The rationale for reporting through accountable officers and ICP's is sound in that it permits maximum utilization at the local level and lateral redistribution as opposed to backhaul.

b. Upon receipt of reports of excess, the ICP screens items to determine if the excesses can be used to fill outstanding requisitions or are needed for depot stocks. Appropriate disposition instructions should be provided the reporting installation as expeditiously as possible, as retention cost could soon exceed potential savings from utilization of some items of materiel. When it is determined that reported excess property is needed for depot stocks, an effort should be made to determine if the property can be stored at the reporting installation to preclude unnecessary handling and transportation cost, since this cost could also equal or exceed potential savings where significant distances are involved.

c. When the ICP determines that the reported property is excess to the needs of the Army, the reporting accountable officer will be instructed to transfer the property to the Defense Property Disposal Officer. Major commands should promptly review listings of excesses that are to be transferred to the property disposal officer to determine if utilization within the command is warranted. Delay of such review could lead to excessive administrative work and unnecessary physical movement.

9-6. Reporting Channels in Overseas Theaters

a. In the overseas theaters, it is important that excess and disposal operations be closely tied to both maintenance and supply operations. A large amount of excess property overseas is generated through maintenance operations and, conversely, proper management of excess property will reduce the maintenance workload. Since the primary objective of any disposal program is maximum utilization, overseas supply managers must have knowledge of disposal programs at all levels, since they can serve as a source of supply. Hence, each reviewing echelon in the operating chain compares excess listings with known and anticipated requirements to preclude unnecessary backhaul or new procurements.

b. Using units in the forward areas of active theaters normally turn in excess property to supporting direct support or general support units as prescribed by theater regulations. Maximum utilization will be enhanced by prescribing that excess property be returned through the supplying unit prior to actual movement whenever the tactical situation will permit. This increases the probability of lateral utilization while decreasing expensive backhaul and multiple handling. Property that is excess to the needs of the direct support and general units is reported to the appropriate theater materiel management center.

c. In the rear areas of overseas theaters, collection and classification companies generate large amounts of potential excess property through their recovery and cannibalization programs. Such property is reported through the materiel management centers for disposition instructions.

d. As a general rule, excess property with line item value of \$50 or more located in overseas theaters will be reported by overseas inventory control centers to the appropriate national inventory control point (NICP) for disposition instructions. Experience has shown that the cost incurred in reporting excess property of lower value generally will exceed the return. As an exception, an NICP may require reporting a specific item with a line item value of less than \$50. NICP screening of excess reports from overseas theaters is similar to that described above for CONUS installation excess reports. However, since potential savings in transportation cost are quite significant, more emphasis is given to lateral redistribution among theaters. Once the NICP manager determines the property is excess to his requirements, the overseas command is directed to transfer the property to the appropriate disposal officer.

Section II. SCREENING OF EXCESS PROPERTY

9-7. Reportability Criteria

a. After property has been transferred to the DPDO, it is DOD policy to encourage all Government agencies to use the materiel in lieu of new procurements, all property becoming excess is not centrally screened for utilization. To assist the logistics manager in the field, criteria for determining what property is reportable for centralized utilization screening have been developed. Generally, these criteria are based on the amount of utilization accomplished within each Federal supply class or group of property that has been subjected to screening, with due consideration being given to the cost involved in effecting the screening. The criteria referred to above stratify excess property as follows:

(1) Declared service or agency excess property reportable DOD or GSA utilization screening (reportable property).

(2) DOD excess property reportable to GSA for utilization screening (reportable property).

(3) Excess property nonreportable and subject only to local area screening (nonreportable property).

b. Reportability criteria are developed by DLA in coordination with the military services and GSA. Detail procedures, including Federal supply class stratification, are published in DOD 4160.21-M and AR 725-50.

c. Because of the constantly changing inventory within the Federal supply system, some flexibility in reportability criteria is desirable. PDO's are encouraged to report excess property for centralized screening whenever it appears to have some reasonable prospect of utilization, regardless of its stratification.

d. Most nonreportable property falls into one of the following categories:

(1) Property determined by competent authority to be classified for reasons of national security.

(2) Property dangerous to public health or safety.

(3) Property used by a single military service, or which has a use potential solely within a single military service; e.g., peculiar arms, ammunition, and implements of war; unit insignia; blank forms.

(4) Perishable property.

(5) Scrap and waste property.

(6) Items manufactured by foreign firms and procured offshore.

(7) Property that does not meet both the minimum line item value and minimum condition criteria of the applicable Federal group or classes published in DOD 4160.21-M will be processed by the DPDO as nonreportable.

e. All other property that meets the minimum line item value and reportability criteria is reported to

the DPDS for appropriate utilization screening within the DOD and/or the GSA.

9-8. Screening of Nonreportable Property or DPDO Account

Excess property not reportable for centralized screening will be given local area screening prior to donation or sale. The type and extent of local screening is determined by the DPDO.

9-9. Screening of Reportable Property or DPDO Account

a. *Types of Screening.* Reportable property is subjected to either DOD and/or GSA screening.

b. *Excess Property Listings.* Excess reports received by the DPDS are used to prepare DOD listing of excess property. Each listing published by the DPDS categories reported excess property by the two-digit Federal supply group. In addition to the detailed descriptive Federal Supply Catalog data, the listings include the following information pertinent to screening actions and subsequent request for effecting transfer:

(1) Listing serial number; e.g., 75/EPPL-41.

(2) The issue date of the excess listing.

(3) The military priority date.

(4) Instructions for obtaining the excess property listed.

(5) Utilization System Control Number (USCN) for reportable non-NSN items.

c. *Distribution of Excess Listings.*

(1) The DPDS distributes excess listings to other military activities and commands specifically designated by the military services, to GSA approved civilian agencies, to authorized foreign governments, and to approved service educational activities. The military Services periodically review the distribution of excess listings to military activities and authorize such changes thereto as may be considered necessary or desirable. Other means may also be used to publicize excess property information when considered appropriate by the DPDS. When means other than excess listings are used, such as direct communications with designated screening activities, adequate screening will be accomplished in a manner consistent with the intent of the Department of Defense Utilization Program.

(2) GSA regional offices distribute or otherwise publicize to military activities excess property information on property that was reported to GSA regions.

d. *Screening Period.* The length of the screening period is controlled by establishing an automatic release date by which a request for excess property must be received. Property not requested prior to this date

will be released for donation. This date is established by the DPDS and the GSA as appropriate.

e. Screening Priorities.

(1) *DOD screening only.* Requests from military activities of the owning military service are given priority during the screening period. Requests received from military activities are normally allocated on a first-come-first-served basis. Following the automatic release data, there is a donation screening period. Requests from service educational activities are given priority during the 21-day donation period.

(2) *Consecutive screening.* Requests from activities of the owning military service are given priority during the DOD screening period on a first-come-first-served basis. Residue items released to GSA by the DPDS are screened by civilian Federal agencies. The GSA regional offices allocate and approve transfer of the materiel to civilian Federal agencies normally on a first-come-first-served basis. Following the automatic release date, 21 days are allowed as the donation screening period.

(3) *Front end screening (FES).* All declared excess assets reported by the DPDO's are screened to determine if they are integrated materiel manager (IMM) controlled or single-service-user items. Assets meeting predetermined criteria are referred to the IMM/ICP for possible utilization. FES procedures are applied prior to any other screening techniques. ICP/IMM's desiring to requisition reportable assets may do so by submitting their requisition to DPDS. Requisitions for nonreportable assets should be submitted to the holding DPDO. All requisitions will contain the FES document number and the applicable fund citation(s) in the remarks section. Reportable

items will be assigned an automatic release date (ARD) and placed in the Excess Personal Property List (EPPL) or forwarded to GSA for screening, as appropriate.

(4) *Final asset screening (FAS).* Subsequent to the DOD/Federal agencies and donation screening prior to preparation of surplus sales catalogs, DPDS will generate a notification of surplus assets to the recorded manager of the National Stock Number (NSN). This is a final screening of available assets prior to sale as Government surplus. ICP's will submit requisitions for required items to the DPDO holding the asset. It must be recognized that these items are being processed for sale; therefore, it is in the best interest of the requiring activity to submit the requisition(s) as soon as possible.

f. Interrogation of Assets.

(1) Interrogation procedures have been designed to promote utilization by providing customers with the capability to selectively interrogate item asset data for all items identified by an NSN in either reportable or nonreportable status from the DPDS.

(2) Asset availability can be interrogated to select assets in a specific condition or a specific geographical location. Interrogations are submitted by NSN's. Want Lists and purge dates can be handled within the Interrogation Requirements Information System (IRIS) (Chapter VIII, DOD 4160.21-M).

(3) Organizations or elements authorized to effect interrogations include, in addition to DPDS organizational levels, Headquarters, DLA, other DOD components; GSA; IMM's; and friendly foreign governments.

Section III. TRANSFER OF EXCESS PROPERTY

9-10. Transfer Among Military and Civilian Federal Agencies

a. For reasons of economy, administrative procedures for transferring excess property should be streamlined as much as possible. However, property accountability must be maintained throughout the screening and transfer process. To preclude uneconomical transfers of excess property, requests for items valued at less than \$50 per line item (regardless of unit cost) are normally not honored. Exceptions are made when the property concerned is the only immediate source of supply.

b. When an Army activity determines that property on a DPDS excess listing is required, it submits a request to the DPDS by telephone, message, or letter. The DPDS has a central computer file of excess property and acts similar to a broker; consequently, requisition forms are not used for this purpose. It is the responsibility of the requesting agency to insure that requests are restricted to those cate-

gories of property that are authorized by appropriate documents.

c. Upon receipt of the request, the DPDS either issues authority to requisition, advises the requesting activity that the materiel is no longer available, or advises that availability must be established with the GSA regional office holding redistribution control.

d. Military screening activities should make every effort to submit requests for materiel undergoing consecutive screening prior to the military priority date to obviate the necessity for subsequently withdrawing the materiel from the GSA regional office.

e. When Army activities have requirements for excess property that has been reported through the DPDS to a GSA regional office for screening and is under the redistribution control of GSA, they submit requisitions to the appropriate GSA regional office.

f. Army activities may also acquire excess civilian Federal agency property offered by the GSA re-

gional offices. Requests for transfer of civilian Federal agency excess property are submitted to the GSA regional office having redistribution control of the property and are restricted to those categories of property that the requesting activity is authorized to acquire.

9-11. Transfer to Foreign Governments

a. Transfers of DOD excess property may be made to foreign governments designated by the Department of State as eligible to purchase property under the Foreign Military Sales Act, PL 90-629. As part of the central screening operation, the DPDS distributes listings of available excess property to these eligible foreign governments based on information furnished by each government as to type of property they desire to screen against requirements. This screening is accomplished concurrently with screening by US Department of Defense activities; however, it cannot be released for sale until screening is completed.

b. Requests for availability are submitted by eligible foreign governments directly to the DPDS for the necessary approval (including State Department clearance, if required), for firm determination of availability of property involved and for action to establish or verify the transfer price.

9-12. Financial Aspects of Transfer

a. Reimbursements.

(1) The inventory manager or other accountable officer informs the DPDO of any designated reimbursement requirements at the time accountability for excess property is transferred to the property dis-

posal account. In the absence of reimbursement data on transfer (of accountability) documents, property disposal officers will consider such property as non-reimbursable. Transfer of property by property disposal officers to DOD users is on a nonreimbursable basis except where the transferee is prohibited by law from acquiring property without reimbursement. Transfers of DOD excess property to civilian Federal agencies will be without reimbursement except when the transferee is prohibited by law from acquiring property without reimbursement or the GSA directs that transfer will be with reimbursement at fair value.

(2) Transfers to eligible foreign governments as a result of DPDS screening operations are made only with reimbursement. Reimbursement for other types of excess property will be no less than the gross cost incurred by the US Government in repairing, rehabilitating, or modifying such articles to the extent required by the receiving government, plus the scrap value or the market value, if ascertainable, whichever is the greater.

b. *Transportation and Accessorial Costs.* Costs of transportation of excess property together with accessorial costs, when appropriate, are borne by the receiving agency. Charges for accessorial costs may be waived, however, where these charges are relatively insignificant. This exception includes parcel post shipments. In addition, these charges are waived for transactions of less than \$50 (DPDS-H 4160.3, Vol. I, Chapter 11J) value for services, work, and supplies, for a receiving activity for any calendar quarter.

Section IV. SALE, ABANDONMENT, AND DESTRUCTION OF FOREIGN EXCESS PERSONAL PROPERTY

9-13. General

a. This section pertains to the sale, abandonment, and destruction of foreign excess personal property. The term foreign excess includes disposal MAP property for the purpose of this section. The standard merchandising policies and practices relating to surplus property will be equally applied to foreign excess sales, subject to the specific provisions of this section.

b. This section applies only to property located outside the Zone of Interior (ZI), American Samoa, Guam, and TTPI. For property located in Canada, only that portion that prescribes the procedures for the determination of property as foreign excess is applicable. In order to conform to an existing agreement between the United States and Canada, the disposition of such property will be in accordance with that specific agreement.

9-14. Statutory Authority

These instructions are based on the authority for the disposal of foreign excess property as contained in the Federal Property and Administrative Services Act of 1949, as amended (40 U.S.C. 511-514) and other pertinent statutes as are referred to herein.

9-15. US Foreign Policy

a. US foreign policy will govern the disposition of foreign excess property whether by sale, donation, abandonment, or destruction. In order that the foreign policies of the United States may be effectively served in foreign countries, foreign excess disposal programs will be developed and conducted with the coordination and approval of the US diplomatic mission in the country concerned. Accordingly, DPDR's or their representatives will maintain close liaison and cooperate with the US diplomatic representatives and consular offices in the country concerned in order

to receive necessary approvals, recommendations, and suggestions from the local US Department of State representative.

b. Requests for deviations to established policy and procedure determined necessary by DPDR's, other than those covered in subparagraph *c* below, will be processed as appropriate to DPDS.

c. In conjunction with assigned responsibilities, DPDR's may deviate from prescribed disposal policy which is in conflict with country-to-country agreements. Copies of oversea command implementations of bilateral agreements will be provided DLA and the headquarters of the military departments concerned.

d. Foreign excess and exchange/sale property will not be sold directly or indirectly to denied areas.

9-16. Liaison With US Department of State

a. Sales Plans and Program.

(1) To preclude delays of proposed sales and to afford appropriate Department of State representatives ample opportunity for consideration of possible foreign policy aspects, sales plans or programs should be developed as far in advance of scheduled sale as possible and processed for coordination and approval.

(2) The Sales Contracting Officer (SCO) will request assistance of the U.S. diplomatic mission, when appropriate, to make an Integrity and Reliability (I&R) Check on every successful bidder prior to award, including named purchaser(s) and subreceiver(s), and to make an "End Use Check" to verify that property reached the acceptable destination designated by the purchaser(s).

b. *Donation, Abandonment, or Destruction of Foreign Excess Property.* The donation, abandonment, or destruction of foreign excess property is also governed by the foreign policy of the United States. Therefore, these actions will be coordinated with the U.S. diplomatic mission and advice obtained on how donation, abandonment, or destruction of foreign excess property can best be accomplished to further U.S. policy.

9-17. Procedures for Coordination With U.S. Department of State

a. The Federal Property and Administrative Services Act of 1949, as amended, requires that disposition of foreign excess and exchange/sale property conform to the foreign policy of the United States. To fulfill this requirement, the following procedures for processing sales of foreign excess and exchange/sale property have been coordinated with the Department of State.

b. The U.S. diplomatic mission of each country where property for an invitation for bid (IFB) is

located will be provided expeditiously a copy of that IFB.

c. The U.S. diplomatic mission will be advised of Munitions List Items (MLI) and MAP excess property that are included in the IFB. DPDR's will consult with U.S. mission personnel before entering into negotiations with friendly foreign governments for the sale of United States MLI's. U.S. mission personnel, for this purpose, means American diplomatic or consular representatives in the country whose government wishes to negotiate the purchase of MLI's as designated in the Department of State's International Traffic in Arms Regulations. This requirement also applies to MLI scrap regardless of the purchaser.

9-18. Abandonment or Destruction

a. Foreign excess property to be abandoned or destroyed, or donated in lieu thereof, will be processed in accordance with Chapter XIV, DOD 4160.21-M. In deference to the significant distances between DPDR Pacific and its subordinate activities, the commander of that region is authorized to delegate his authority to approve abandonment or destruction actions. Such delegations will not be effected to PDO's or DPDO's.

b. The following subparagraphs deal with donation in lieu of abandonment destruction.

(1) With the exception of property, dangerous to public health and safety, foreign excess property may be donated to organizations specified below, upon proper findings that the property is donable. Assistance in obtaining information on the activities or organizations unknown or not familiar to the installation concerned should be requested from the local representative of the Department of State. Preference will be given to eligible donees in the order listed below. Donations may be effected without cost to any:

(a) Organization, institution, or agency of the United States Government.

(b) Organization, institution, or agency of any friendly foreign government or local subdivision thereof.

(c) Nonprofit scientific, literary, educational, public health, public welfare, charitable institution, hospital or similar institution, organization or association in a friendly country, provided its activities are not adverse to the interests of the United States. Written request from a donee will include, as a minimum, a brief statement of its activities, general information as to the use to be made of the requested property, and a statement that the property is needed and is being acquired for such purposes and will not be resold or put to any other use. Donations may be made to foreign nonprofit institutions, but preference shall be given to those organized under the laws of the United States or any territory, State, or pos-

session thereof, and supported in whole or in part through use of funds raised chiefly from sources in the United States, its territories, or possessions.

(2) The advice of the local representative of the Department of State will be obtained as to how donation of foreign excess property will be made so as to serve the United States foreign policy interests and objectives in the area. Local arrangements between representatives of the Department of State and the DPDO should be sufficiently flexible to permit advice covering donation of foreign excess property on a continuing basis, subject to periodic review, as necessary, rather than on a case-by-case review. The advice of the representative of the Department of State will be given consideration in reaching a decision as to the receipt of the property to be donated.

(3) The American National Red Cross should be advised and offered, before donating to other agencies, property which can be readily identified as originally processed, produced, or donated by the American National Red Cross.

9-19. References

a. Army Regulations (AR).

710-2 Materiel Management for Using Units, Support Units, and Installation.

725-50 Reporting, Utilization, and Redistribution of Installation, US Army Materiel Command, and Oversea Command Excess Personal Property.

755-4 Exchange or Sale of Nonexcess Personal Property.

755-15 Disposal of Unwanted Radioactive Materiel.

b. Department of Defense Publications.

4000.19-M Basic Policies and Principles of Interservice, Interdepartmental, and Interagency Support.

4140.34-M Department of Defense Utilization Manual.

4160.21 Department of Defense Disposal Program.

4160.21-M Defense Disposal Manual.

4160.21-M-1 Defense Demilitarization Manual.

c. Department of Defense Instruction.

4160.1 Nonexcess Personal Property to be Sold or Exchanged for Replacement Purposes.

4160.21-M Interrogation Requirements Information System.

d. Defense Logistics Agency Handbook.

4160.1 Defense Scrap Yard Handbook.

By Order of the Secretary of the Army:

Official:

J. C. PENNINGTON

Major General, United States Army
The Adjutant General

E. C. MEYER
General, United States Army
Chief of Staff

3000031526

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